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FM 44-9

DEPARTMENT OF THE ARMY FIELD MANUAL

AIR DEFENSE ARTILLERY FIRE DISTRIBUTION SYSTEM AN/TSQ-51 (U)

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By RMDA

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FIELD MANUAL
No. 44-9

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *1 August 1967*

AIR DEFENSE ARTILLERY FIRE DISTRIBUTION SYSTEM AN/TSQ-51 (U)

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CHAPTER 1 (U)

INTRODUCTION (U)

1. (U) Purpose and Scope

This manual is a guide for commanders and operating personnel in the use of air defense artillery fire distribution system AN/TSQ–51, also known as Missile Mentor. The system serves the AADCP and is the means used by the commander to coordinate the fires of a number of air defense artillery missile batteries. This manual contains a general description of the system, a discussion of organization, a description of operating equipment, and detailed operating instructions.

2. (U) Recommended Changes and Comments

Users are encouraged to submit recommended changes and comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U.S. Army Air Defense School, ATTN: AKBAAS–DR, Fort Bliss, Texas 79916.

3. (U) References

References containing material supplementing this manual are listed in the appendix.

4. (U) AN/TSQ–51 Installations

Normally the AN/TSQ–51 fire distribution system equipment will be operated in the trailers which house the equipment; however, some Army air defense commanders may desire to remove the equipment from the trailers and emplace it in a building or buildings.

5. (U) Safety

a. This equipment employs voltages which may be fatal if contacted. Extreme caution should be exercised when working with the equipment.

b. While every practical safety precaution has been incorporated in the equipment, the following rules must be strictly observed:

(1) *Keep away from live circuits.* Operating and maintenance personnel must follow safety regulations at all times. Do not change electronic components or make adjustments inside equipment with high-voltage supplies energized.

(2) *Do not tamper with interlocks.* Under no circumstances should any cover plate, door, or safety interlock switch be removed, bypassed, short-circuited, or tampered with in any way by other than authorized maintenance personnel. Do not rely on interlock switches to remove high voltages from the equipment.

(3) *Make no connections with power applied.* All external cables from the power source (commercial or tactical generators) to the trailers and the external cables between trailers, should be connected to their proper receptacles or plugs with the power OFF.

(4) *Do not service or adjust alone.* Under no circumstances should any person reach inside the equipment without the immediate prsence of another person capable of rendering aid.

c. FM 21–11 describes first-aid treatment for electrical shock.

6. (U) Composition of Operating Sections

a. Current TOE for air defense artillery brigades and groups do not provide the personnel and equipment required to operate and maintain the AN/TSQ–51 fire distribution equipment and must be augmented as follows:

(1) Command post headquarters section.

(2) Monitoring and data processing section.

(3) Maintenance section.

(4) Remote radar integration station section.
(5) Fire distribution operator team.
(6) Terminal data link repair team.
(7) Special requirements section.

b. Every defense will not contain the same number of fire units and not all defenses will use a remote radar integration station (RRIS) therefore, the augmentation requirement for each defense will vary.

c. The composition of the various sections and the general duties of personnel follow:

(1) The command post headquarters section is comprised of a section leader, operations sergeant, general clerk, and four journal clerks. The section leader and operations sergeant provide for the normal command and control of the AN/TSQ–51 system. The journal clerks, one per shift, are provided to continuously maintain tactical status records which include fire unit ammunition expenditures, track engagement and kill information, message logs, codes and authentications, and other data pertinent to compilation of after-action reports. The general clerk has been included to act as a messenger, maintain operational and maintenance records, and type required forms and reports.

(2) The monitoring and data processing section is comprised of four tactical directors, four tactical director assistants, and eight fire distribution operators. This is the base organization for manning three fire distribution operator consoles and one tactical director's console (all designated as general purpose consoles) on a 24-hour basis with one tactical director, one tactical director assistant, and two fire distribution operators per shift. Four is the minimum number of consoles that will be used in any defense; consequently, the above personnel are the minimum number required to fully man this base augmentation.

(3) The maintenance section is comprised of a fire distribution maintenance technician, a repair supervisor, five AN/TSQ–51 repairmen, four terminal data link repairmen, a signal supply parts specialist, and a supply clerk. This section is responsible for both organizational and support-type maintenance functions for the AN/TSQ–51 equipment, and support-type maintenance functions for the terminal data link (TDL) equipment located at the missile batteries. When more than six missile batteries are associated with a defense, additional TDL repairmen are required. The signal supply parts specialist is included to provide for storage, requisitioning, and records maintenance for spare parts. The supply clerk is included to provide for delivery of TDL parts to missile batteries when a TDL repairman is not required, to procure and transport repair parts from the supporting installation to the AN/TSQ–51 site, and to assist the signal supply parts specialist in managing the repair parts program.

(4) The remote radar integration station section (when used in a defense) is comprised of a section chief, four fire distribution operators, four AN/TSQ–51 repairmen, and a signal supply parts specialist. These personnel are the minimum required to operate and maintain an RRIS on a 24-hour basis. This section provides for both operations and organizational and support-type maintenance functions for the RRIS. The RRIS has only one general purpose console. The signal supply parts specialist is included to provide for storage, requisitioning, and records maintenance, and to procure and transport repair parts from the supporting unit to the RRIS site.

(5) The special requirements section consists of three precise power generation specialists and one engineer missile equipment mechanic. The precise power generation specialists are provided to operate and maintain, on a 24-hour basis, power generation equipment associated with the AADCP or RRIS equipment. This number of personnel is essential because of the critical power requirements of the system for the 24-

hour operational requirements. One power generation specialist must be on the equipment while it is operating to perform adjustments, checks, and servicing to maintain the equipment in peak operational condition. The three power generation specialists provide a three-shift capability to operate and maintain these generators and to perform more extensive organizational maintenance on standby generators. The engineer missile equipment mechanic is provided for the maintenance of component air conditioners and heaters of the AADCP or RRIS.

(6) The fire distribution operator team is comprised of four fire distribution operators. One team is provided for each additional general purpose console over and above the normal four consoles in the AADCP. Four operators are necessary to satisfy the 24-hour manning requirement. When used, this team becomes a part of the monitoring and data processing section.

(7) The terminal data link repair team is comprised of one TDL repairman. One team is provided for each two additional missile batteries added to a defense. This team provides support-type maintenance of the TDL equipment. When used, this team becomes a part of the maintenance section.

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CHAPTER 2 (C)

SYSTEM DESCRIPTION (U)

7. (U) General

a. The fire distribution system serves as a control element for the AADCP, providing a link between the semiautomatic ground environment/backup interceptor control (SAGE/BUIC) direction center and the Nike Hercules/Hawk missile fire units.

b. To make the most effective use of his defense capabilities, the Army air defense commander (AADC) must know the combat readiness of his units, weapons availability, unit capabilities, numbers and location of fire units, the airspace situation (friendly as well as hostile), and the air defense warning condition. Thus the AN/TSQ–51 facilities must provide the following air defense functions:

(1) *Detection.* The system must be capable of discovering the presence of an airborne object at ranges which will allow the system to respond in sufficient time for successful engagement.

(2) *Tracking.* The position of the airborne object must continually be observed with adequate range and azimuth accuracy so as to provide continuous position information.

(3) *Identification.* The intentions of the airborne object must be weighed and its identity established.

(4) *Threat evaluation.* If the airborne object indicates a hostile intent, the system must relate its threat to that of other potential hostiles, thereby helping the commander in deciding how much force should be used against it.

(5) *Weapon coordination and supervision.* The selected target must be designated to a fire unit or units which must be monitored, coordinated, and supervised to insure effective and efficient use of available weapons.

(6) *Damage assessment.* Target damage must be assessed to learn whether reengagement is required.

(7) *Data exchange.* The system must be capable of exchanging pertinent data efficiently with SAGE/BUIC, fire units, RRIS's, and adjacent AADCP's.

8. (C) Capabilities

a. There is no acquisition or search radar as a component of the AN/TSQ–51 fire distribution system, therefore the system must be collocated with an acquisition or search radar as its source of raw radar video and target position. One of the design features of the system is that it is capable of operating with any existing Army acquisition radar, including three-dimensional and height-finder radars, and many Air Force surveillance radars.

b. Three types of video in any combination can be presented on the plan position indicator (PPI) of an operator's console. These are *target* video (RF energy reflected from the surface of an object), *identification friend or foe* (*IFF*) video—also called beacon video—(RF energy transmitted by an object), and correlated video (target video or IFF (beacon) video processed by the AN/TSQ–51 for automatic tracking). Only one type (target or IFF) can be selected at a time for automatic tracking, but both types can always be rate-aided, manually initiated, tracked (RAMIT).

c. To augument and act as a gap filler for a defense, a component part of the system, called a remote radar integration station (RRIS) is provided. This equipment, like the AN/TSQ–51 equipment used at the AADCP, must be collocated with an acquisition radar. Automatic tracking

by the RRIS is not available and local target video can be tracked only in the RAMIT mode. The RRIS exchanges track data with the AN/TSQ–51 equipped AADCP which insures, through overlapping radar coverage, that undetected penetration of the defense by hostile targets is reduced to a minimum.

d. The equipment used at the AADCP is capable of processing track data on 256 tracks of which 64 are local tracks, 64 from SAGE/BUIC, and 128 from remote sources (RRIS's or adjacent AADCP's). When operating without a link with SAGE/BUIC, the number of local tracks which the system can handle is increased to 96. The RRIS equipment is also capable of processing 256 tracks, of which 32 are RRIS local tracks and 224 are remote tracks received by the RRIS from the parent AADCP equipment.

e. Normally the U.S. Air Force is responsible for identification of airbrone objects. The acquisition radar used with the AN/TSQ–51 is equipped with IFF equipment, as are all acquisition radars in a defense, which aids in target identification and provides the beacon for beacon tracking. When beacon tracking is used, only tracks responding with a beacon signal are tracked automatically. All other tracks must be tracked in the RAMIT mode.

f. Only the enemy knows when, how, and from which direction attempts will be made to penetrate a defense. Certain areas within a defense, which are considered prime areas to be defended, called graded areas, are known to the system's computer. Any hostile or unknown track, which by its actions indicates a threat to any defended area, is categorized by a prepared program in the computer which decides the degree of threat that the track offers, *high*, *medium*, or *low*. Targets which offer a high threat will cause the track symbol associated with it to blink. When the operator takes close control of the track, the threat degree will be indicated on the action entry panel of the operator's console.

g. Fire unit supervision and monitoring of fire units is accomplished through use of digital data links backed up by voice communications. The system is capable of integrating any combination of Nike Hercules and/or Hawk fire units up to a maximum of twenty-four. Fire units normally will engage targets on their own initiative. However, to prevent overkill or nonengagement of targets, the Army air defense commander monitors all actions by the fire units and initiates necessary corrective action to insure that targets are properly engaged while an overall balanced defense is maintained.

h. When multiple-target tracks have been engaged and fired upon, the AADCP has the responsibility of determining if the engagement was successful and that all targets have been destroyed. Through the use of radar displays, personnel at the AADCP will survey the target area and confirm the fire unit kill or initiate the commands for further engagement. If the track was local and no video remains, AADCP personnel cause the track to be dumped from the system. If the track was initiated at a remote facility, the AADCP personnel will send a dump request to that facility.

9. (C) System Composition

a. All of the equipment which make up the AN/TSQ–51 fire distribution system is housed in temperature-controlled trailers. The equipment used at an AADCP is housed in two trailers, the equipment trailer and the operations trailer. Although it may not be employed in a defense, a third temperature-controlled trailer, which houses the RRIS equipment, is part of the AN/TSQ–51 system. The temperature control within the trailers is for operator comfort only.

b. The equipment trailer (fig. 1) houses the following items of equipment:

(1) *Power and signal distribution rack.* All external power and signal cables are connected to the back of the rack through apertures cut into the end wall of the trailer. AC power and data signals are routed through installed cabling to various other equipment requiring ac power or data signals.

(2) *Master control panel.* This control panel, located on the front inside wall of the trailer, contains the switches and controls necessary for controlling operation of the personnel heating and air conditioning equipment.

(3) *Power rack.* The power rack, along with the tracking, ADL 1, and ADL 2 racks, is mounted on the inner left side of the

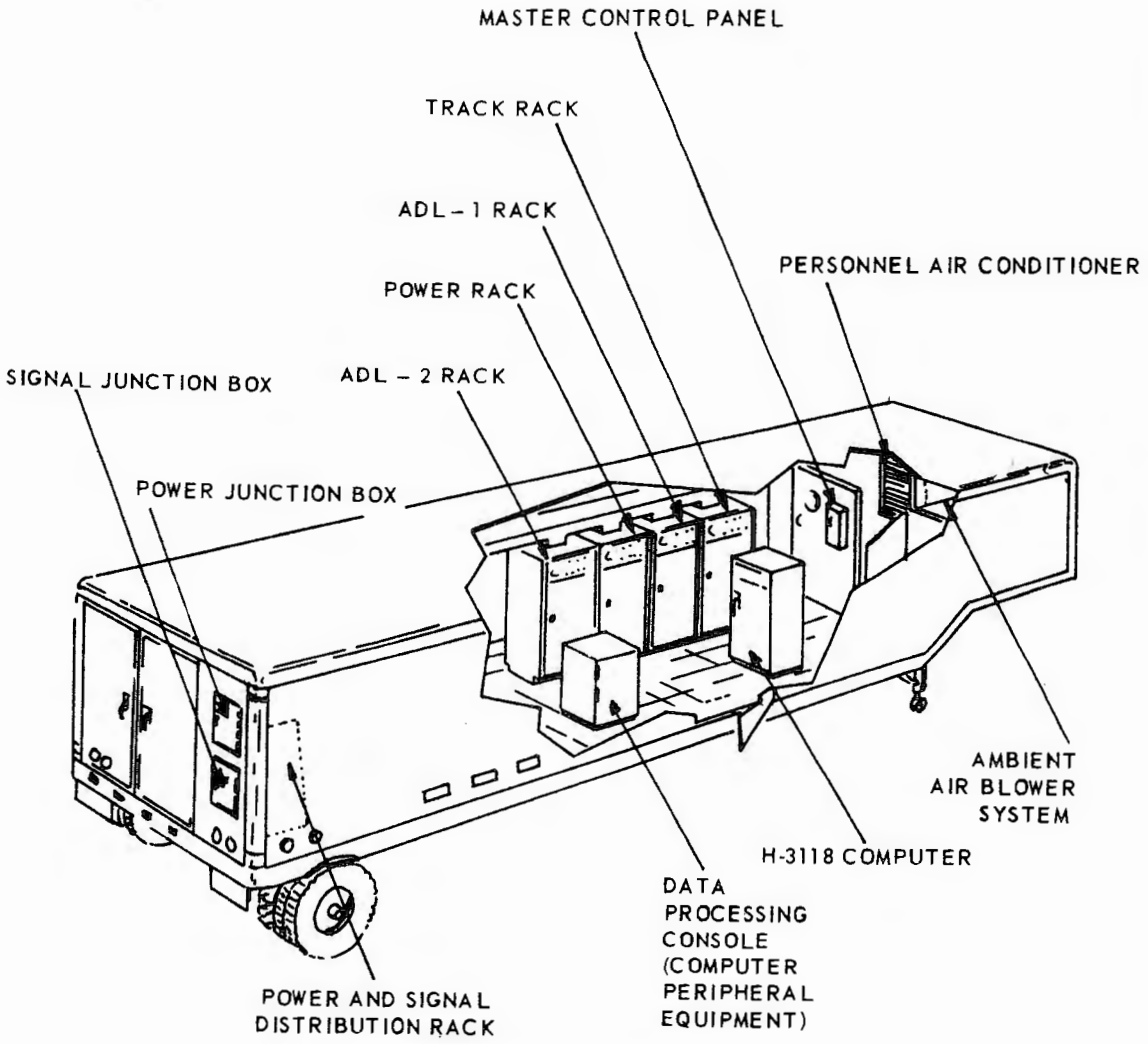

Figure 1 (U). Equipment trailer (U).

trailer. The functions of the power rack are to generate and distribute to the ADL racks and the tracking racks the dc voltages necessary for their operation. The power rack also contains the display buffer which controls two-way communication between the console displays, indicators, and switches, and the computer.

(4) *Tracking rack.* Inputs to the computer must be in digital form so that the computer can act upon the information. The tracking rack receives position information and video from the acquisition radar, and converts these data into the proper digital form for use by the computer. The tracking rack also supplies video for display on the general purpose consoles.

(5) *ADL racks.* There are two ADL racks used in the system. ADL 1 rack provides the digital data link terminal between the AADCP computer and SAGE/BUIC, adjacent AADCP's, and the associated RRIS's. ADL 2 rack acts as the digital data link terminal between the computer and associated fire units. All digital data, incoming and outgoing, must pass through these ADL racks.

(6) *Computer.* Some data used in the system remains unchanged while other data are continually changing. The computer, operating at high speed, processes incom-

ing and outgoing digital messages; accepts, stores, extrapolates, and correlates track data; performs all required arithmetic operations; provides for automatic tracking of targets; and processes and organizes data for display on the operators' consoles. It also processes console operator decisions and requests for data and generates map data for display. Because all functions performed by the computer are done automatically, no operator is required.

(7) *Computer peripheral equipment.* This equipment is comprised of a standup console on which is mounted an electric typewriter, a paper/mylar tape reader, and a paper/mylar punch and spooler. During normal operation, this equipment is not used. Maintenance personnel make use of the typewriter to make minor changes, as required, to the computer operational program. During certain maintenance checks, the computer outputs to the typewriter and the information thus typed is used in determining overall system performance. The tape reader is used to place operational and diagnostic programs into the computer. Conversely, the tape punch is used to punch on tape any information or programs from the computer.

(8) *Air conditioning and heating equipment.* Mounted in the front end of the trailer is heating and air conditioning equipment provided for personnel comfort. There is also an ambient air blower and ducting system provided for use with the operational equipment to circulate air through the equipment cabinets. The AN/TSQ–51 equipment is designed operationally so that it is capable of operating without cooling or heating equipment, using only normal circulating air.

c. The remaining area in the equipment trailer is used by maintenance personnel for storage of spare parts, tools, and test equipment. A workbench is furnished to provide a working area for bench repair of equipment by maintenance personnel.

d. The operations trailer (fig. 2) houses the following items of equipment:

(1) *General purpose consoles.* Up to eight of these identical consoles can be accommodated in the operations trailer, being placed in such manner that all operators face the front of the trailer. A detailed description of the general purpose console, its functions and operation, is contained in chapter 4.

(2) *Power and signal distribution rack.* This rack serves the same function in the operations trailer as does the power and signal distribution rack in the equipment trailer in that ac power, data signals from the equipment trailer, and communications are routed through the rack before being distributed to other equipment.

(3) *Plotting board.* Fastened by hinges to the ceiling on the inside forward portion of the trailer and in view of all console operators when swung down and locked in place, is a manual plotting board which is used during manual AADCP operation. Under normal operating conditions, the plotting board is maintained in its stowed position (swung upward on the hinges and locked to the ceiling) so that the status panels are not blocked from the view of the console operators (fig. 2).

(4) *Status panels.* Installed on the front wall of the operations trailer are two status panels which supply AADCP personnel with information pertaining to a maximum of 24 fire units. Some information displayed is manually inserted, while other information is obtained from the computer. A detailed explanation of the status panels is contained in chapter 5.

(5) *Display rack.* Located in the left rear corner of the operations trailer is the display rack. This equipment serves as the link between the general purpose consoles and the computer located in the equipment trailer. It contains a symbol generator which generates symbology for presentation on the PPI's and a control panel whose switch settings determine the category of reference tracks (friendly or hostile) which are transmitted to the fire units, and whether the automatic tracking function should operate in the beacon or skin-tracking mode.

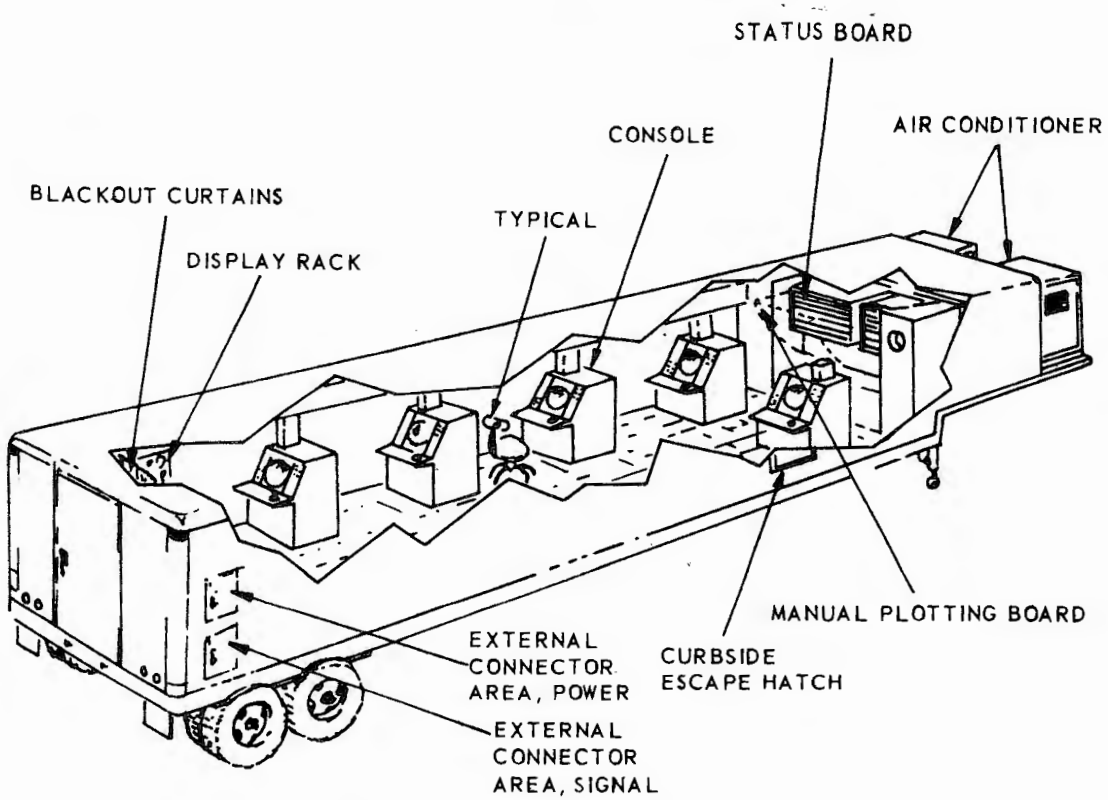

Figure 2 (U). Operations trailer (U).

(6) *Air conditioning and heating equipment.* This equipment is the same as that furnished with the equipment trailer, but because more personnel will be operating in this trailer, there are two heating units and two air conditioning units. The general purpose consoles will generate more heat than other equipment and because these consoles will be mounted on each side of the trailer, two ambient air blowers and ducting systems are provided, one blower and ducting system serving the consoles on the left side, the other serving those on the right side.

e. The RRIS trailer (fig. 3) houses the following items of equipment:

(1) *Power and signal distribution rack.* Similar to the power and signal distribution racks in the operations and equipment trailers, this rack in the RRIS trailer is the connecting link between the equipment trailer and associated equipment (generators, radar, etc.). Here again ac power and data signals are distributed through the rack and installed cabling to the other equipment.

(2) *Master control panel.* Located on the front inner wall, the same as in the equipment trailer, this control panel contains the switches and controls necessary for controlling operation of the personnel heating and air conditioning equipment.

(3) *Power rack.* The equipment contained within this rack generates the dc voltages required for operation of the data rack. It also contains the display buffer.

(4) *Data rack.* Because the RRIS does not have an automatic tracking capability and has fewer consoles and less ADL requirements than the AADCP equipment, the amount of equipment required is less. Where the AN/TSQ–51-equipped AADCP had separate items of equipment for the display functions, ADL, and tracking, the one data rack of the RRIS houses all components used to perform these functions. Because rate-

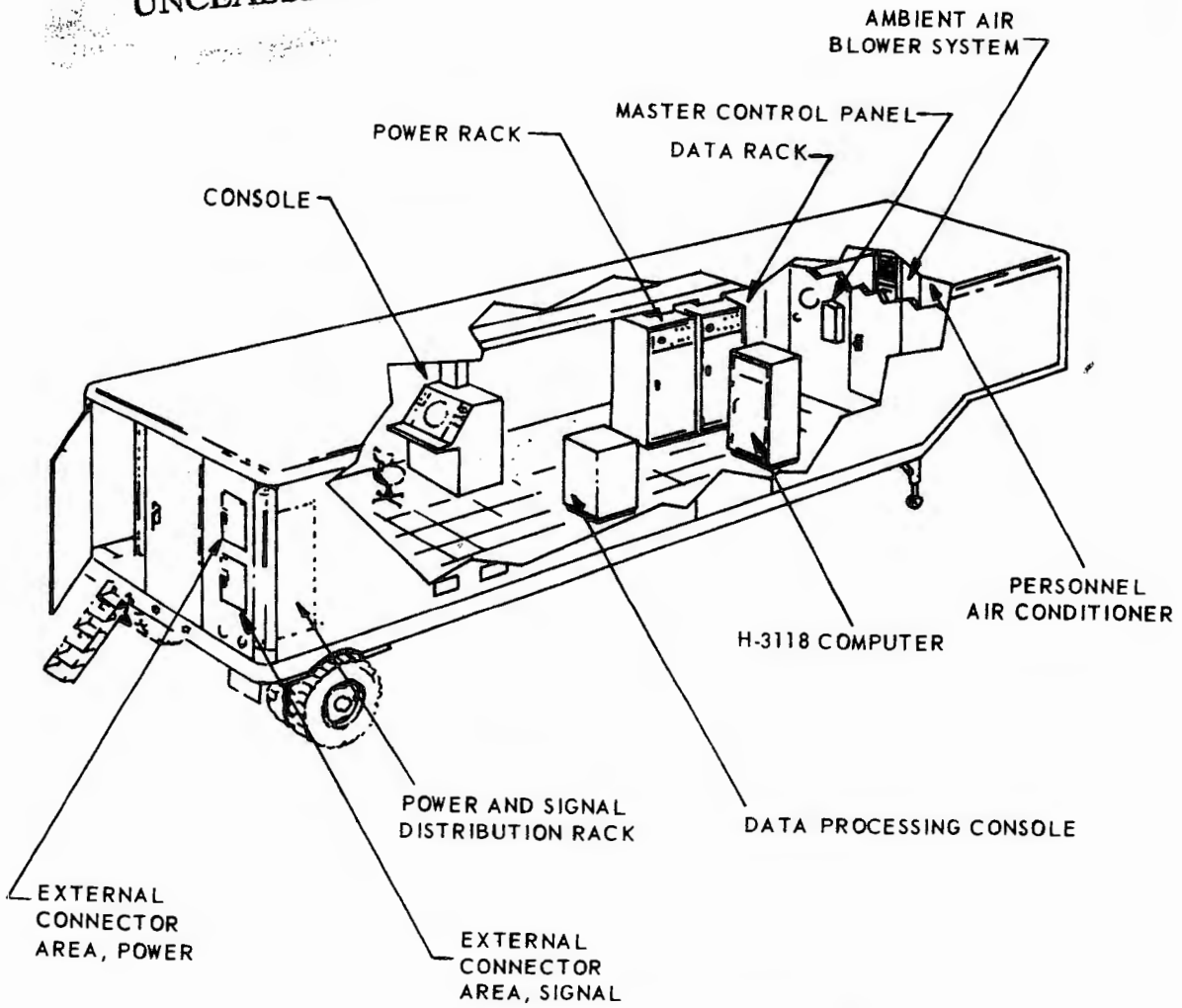

Figure 3 (U). Remote radar integration station trailer (U).

aided, manually initiated tracking only can be performed, not as much equipment is needed by the RRIS.

(5) *Computer.* The physical size of the RRIS computer is the same as the computer used at the AADCP; however, the electronic components are reduced because of the lesser capabilities of the RRIS.

(6) *Computer peripheral equipment.* This equipment is the same as that provided in the equipment trailer at the AN/TSQ–51-equipped AADCP, except that no tape punch is furnished. The functions which the typewriter and tape reader perform are the same as those in the AN/TSQ–51 peripheral equipment.

(7) *General purpose console.* Only one console is provided; however, space is allotted for three additional consoles if needed. This console is interchangeable with those used in the AN/TSQ–51-equipped AADCP, but through computer programing, only the tracking mode of console operation is available.

(8) *Air conditioning and heating equipment.* Located in the front portion of the trailer is the personnel air conditioning and heating equipment and the ambient air blower. Installed ducting connects the general purpose console, power cabinet, and data cabinet to the ambient air blower.

CHAPTER 3 (C)

DATA EXCHANGES (U)

10. (C) General

a. An AADCP equipped with AN/TSQ–51 equipment can exchange information at high speeds with SAGE/BUIC, fire units, adjacent AADCP's, and associated RRIS's. This high-speed exchange is obtained through the use of automatic data link (ADL) equipment. In CONUS, communications equipment is supplied by commercial facilities.

b. The configuration of defenses will vary, consequently each data link network is tailored to meet the needs of a particular defense. Not all defenses will have an RRIS nor will all AN/TSQ–51-equipped AADCP's have an adjacent AADCP with which data are exchanged. Some defenses could have one or more RRIS and could tie in with one or more adjacent AADCP. Nevertheless, the AN/TSQ–51 equipment has built-in facilities for exchanging data with up to five remote sources (adjacent AADCP's or associated RRIS's) in any combination. At a maximum, any defense could have its AN/TSQ–51-equipped AADCP linked with SAGE/BUIC, 5 remotes, and 24 fire units (fig. 4).

c. The AN/TSQ–51 system, having stored in its computer memory the location of its own site and the location of associated RRIS's and adjacent AADCP's, processes the track coordinate data received from these sources and corrects these data so that they are displayed with respect to the AADCP's grid origin. Track data from SAGE/BUIC are processed in the same manner. Data received from fire units are parallax-corrected before transmission by the fire units, therefore no correction is required at the AADCP. Conversely, fire unit terminal equipment parallax-corrects any *received* track data so that it is referenced to its own grid origin before any display is made. The AN/TSQ–51 equipment at the AADCP parallax-corrects all track coordinate data received (except from fire units) while fire unit terminal equipment parallax-corrects the data both before transmission and upon reception.

11. (C) Coordinate Grids

a. Each AADCP and fire unit is located in the center of its own coordinate grid, which for Hawk fire units is 160 data miles square; for Nike Hercules fire units is 320 data miles square; and for an AADCP or RRIS is 1,280 data miles square. (A data mile is equal to 2,000 yards.) The grid of each system is based on the range capability of the acquisition radar plus an area beyond for display of early warning information. Fire units normally are sited to have overlapping fire coverage, consequently portions of the coordinate grids overlap.

b. Figure 5 shows the relationship between an AN/TSQ–51-equipped AADCP, its associated RRIS, and subordinate fire units (Hawk and Nike Hercules). Note in figure 5 that the target (T) appears only in the coordinate grid of fire unit No. 3. A target may appear within the boundary of a coordinate grid, yet not be displayed on a PPI due to the latter's circular construction. However, as soon as a target which is an active track comes within range of the PPI, the track symbology will be displayed. When the target comes within range of the acquisition radar and is detected, video for the target is also displayed.

c. Establishment of the correct grid relationship between these agencies which exchange data insures minimum errors. An explanation of the different data exchanges is made in paragraphs 12 through 15.

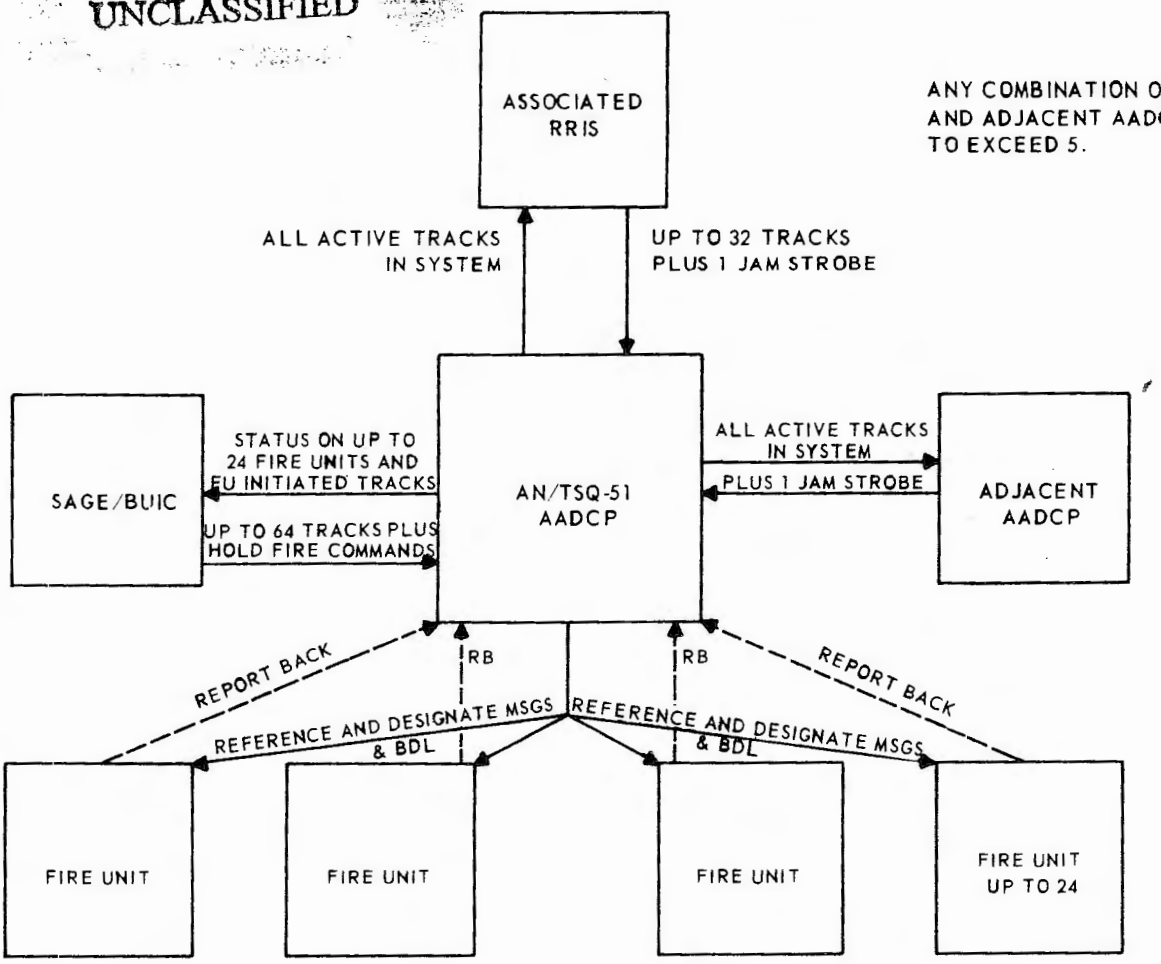

Figure 4 (C). AN/TSQ–51 data exchanges (U).

12. (C) AN/TSQ–51-Equipped AADCP and SAGE/BUIC

a. The AN/TSQ–51 equipment used at an AADCP can receive from SAGE or its alternate, BUIC, data on as many as 64 tracks for which identity (friendly or hostile) has been determined at SAGE/BUIC. Not all such tracks will be within the range of the AADCP-collocated radar, but will be within the range of the area covered by the PPI. This provides early warning at ranges where the AADCP can alert its subordinate fire units and associated RRIS's.

b. Data messages from an AN/TSQ–51-equipped AADCP to SAGE/BUIC consist primarily of fire unit status messages which keep SAGE/BUIC continually informed as to the status of the fire units. The information contained in the message is *out of action*, *ready*, *tracking*, or *firing*, indicating fire unit status, and results of any engagement which are *kill*, *effective*, or *ineffective*. A validity (pop-up) message is a type of status message which is transmitted to SAGE/BUIC whenever a fire unit is tracking a target (initiated by the fire unit) not received from the AADCP. The validity message is transmitted as part of a normal status message only when the foregoing occurs.

c. The remaining message from an AN/TSQ–51-equipped AADCP to SAGE is a *request-for-dump* initiated by a console operator by pressing the DROP TRACK pushbutton while the console is hooked to a SAGE track. SAGE responds to the request by sending a *dump* message to the AADCP which causes the track to be removed from the AN/TSQ–51 equipment track stores.

d. Data contained in a message from SAGE consists of X, Y, and H coordinate data; X and Y velocity data; track number; raid size; and

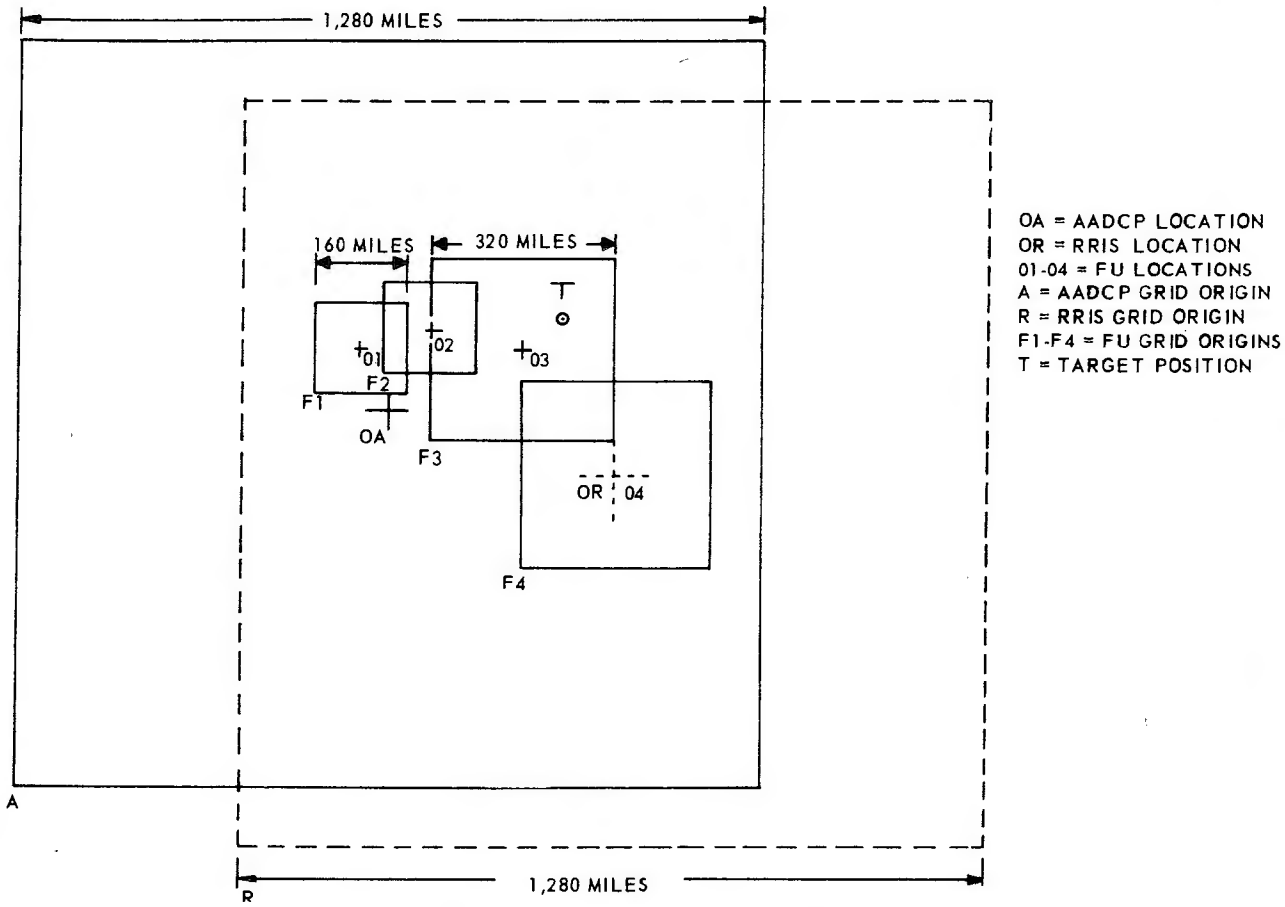

Figure 5 (C). AADCP, RRIS, and fire unit grids (U).

identity. If SAGE desires to hold fire on a specific track, the message for that track would include a *hold fire*.

e. Data contained in a message from an AN/TSQ–51-equipped AADCP to SAGE consists of fire unit status; fire unit number; raid size, and SAGE manual (if the AADCP has a SAGE track under local manual control). It will also include X, Y, and H coordinates of a target if the fire unit is firing or tracking (site coordinates of the fire unit if not so engaged) and if a *request-for-dump* has been made (included along with the track number).

13. (C) AN/TSQ–51-Equipped AADCP and Fire Units

a. An AN/TSQ–51-equipped AADCP transmits data messages to its subordinate fire units only for those tracks active in the system for which *identity* has been established and selected by *identity* for transmission as reference tracks or those that have been manually referenced by a console operator. A track that has been designated to one or more fire units for engagement automatically is sent to all other fire units in a defense as a reference track after the designated fire unit has acknowledged, regardless of reference track transmission selection instituted by AADCP personnel. The reason for limiting the number of tracks sent to the fire units is to prevent cluttering the PPI at the fire units with unnecessary symbology. Therefore, the AADCP tactical controllers restrict the flow of track information going to the fire units to those tracks which will be of interest—those which are being engaged, those offering a

threat to the defense, or those requiring special attention.

b. Fire units also receive from the AN/TSQ–51-equipped AADCP data messages which contain information relative to all fire units in a defense. These messages are called battery data link (BDL) messages. At any fire unit, the location of all other fire units will be displayed when the BATTS/NORMAL switch on the battery control console is turned to BATTS. If any units are tracking targets, the positions of the tracking fire units are replaced by target coordinates which the unit's fire control equip nent is computing. When selected for display, this data informs any fire unit what the other fire units in the defense are doing—*not active* by display of fire unit position or *active* by displacement of the symbology to the coordinates of a target. The AN/TSQ–51 equipment has facilities built in that allow any BDL messages to flow to all fire units even upon failure of the system computer.

c. Track messages transmitted by an AN/TSQ–51-equipped AADCP to its fire units always contain—

(1) Category (designate or reference message).
(2) Identity (friendly or hostile).
(3) Commands (only if a designate—then engage, hold fire, or cease engage).
(4) Raid size (no estimate, one, few, or many).
(5) Hawk identifier (only required for Hawk batteries—either firing section can be designated a track).
(6) Coordinate data (track coordinates as X, Y, and H).

d. A message transmitted to one or more fire units as a designate message will have a change in the category portion and will include a command. Only the units for which the message is intended will receive the designate—all other units will receive the message as a reference message after the designated fire unit has acknowledged.

e. Fire unit messages transmitted to an AADCP are called *report-back* messages and are the means by which the fire unit replies (via ADL) to a signal called *interrogate*. This interrogate signal is placed on the ADL to each fire unit even when no reference tracks are being transmitted. When the signal is received at the fire unit it causes the *report-back* message to be automatically transmitted to the AN/TSQ–51 equipment at the AADCP. Failure by any fire unit to respond to an interrogate signal causes the AN/TSQ–51 equipment to recognize this lack of response and causes that unit to be carried in the system as *status unknown*.

f. This failure to reply should not be construed as meaning that the fire unit is physically out of action, only that the unit did not reply by ADL. Verification of the fire unit's status must be confirmed by voice communication.

g. At the AN/TSQ–51-equipped AADCP, report-back messages are processed for the data which they contain and are also routed to all fire units as BDL information. In the event the computer in the AN/TSQ–51 system becomes inoperative, provisions have been made within the system to continue the flow of BDL messages to the units through a switch-controlled process known as *interim battery data link* (IBDL). In the IBDL mode, any one report-back message is transmitted to all fire units except to that fire unit originating the message. The switches which control the IBDL mode are located on an ADL equipment rack in the equipment trailer and their use will be governed by local SOP.

h. When a fire unit receives a message containing a command (ENGAGE, CEASE ENGAGE, or HOLD FIRE), it must respond with acknowledgment of the command. This is accomplished at the fire unit by pressing the ACKNOWLEDGE pushbutton on the battery control console. This action causes the unit's report-back message to contain a code which, when processed at the AN/TSQ–51-equipped AADCP, informs AADCP personnel that the command was received.

14. (C) AN/TSQ–51-Equipped AADCP and RRIS

a. An associated RRIS receives from the parent AN/TSQ–51-equipped AADCP data on all tracks in its equipment computer memory. This gives the RRIS a complete picture of the air defense situation as it exists at the AADCP. The RRIS, in turn, transmits to its parent AADCP track data on as many as 32 RRIS-initiated tracks, data for one jam strobe, and data on as many as 8 of the tracks received from the parent AADCP but which the RRIS operator has marked as special (per unit SOP) for action back at the AADCP.

b. The parent AADCP AN/TSQ–51 equipment processes all data received from RRIS and, if the data for a RRIS-initiated track (except for a jam strobe and specials) correlates with an already existing AADCP track, the message containing the data for a correlated track is stored in the computer memory but not displayed on the consoles. Because the AN/TSQ–51 system transmits data on all tracks (including remotes of which the RRIS is one), any track originating at an RRIS and recirculated back to it by the AADCP is rejected at the RRIS in the same manner that correlated tracks are rejected at the AADCP by checking the source code in the message to determine the originator of the track. A jam strobe message from an AADCP is not accepted at an RRIS.

15. (C) Adjacent AN/TSQ–51-Equipped AADCP's

a. Any AADCP using AN/TSQ–51 equipment can exchange data, via ADL, with adjacent AADCP's using like equipment on all tracks plus one jam strobe active in the system. However, only those tracks which are being *engaged* or have been flagged as *specials* will be accepted by the receiving AADCP. This cross-telling feature provides adjacent AADCP's with information on tracks in areas of mutual interest without overloading an AN/TSQ–51 equipment memory store with unwanted or unneeded track data.

b. Once an AN/TSQ–51-equipped AADCP accepts and stores a remote track, it continues to accept data for that track until the track is dumped at the source where the track is a local track. If a track which is being sent from one AADCP to another is a track originated at SAGE/BUIC, and satisfies the criteria established by the receiving AADCP for acceptance, it will be displayed as a remote track with the alphanumeric source code of the AADCP doing the transmitting.

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CHAPTER 4 (C)
GENERAL PURPOSE CONSOLE (U)

Section I. BASIC DESCRIPTION

16. (U) General

The display console is the man/machine connecting link and must be capable of presenting a clear, unambiguous display of the tactical situation which the operator can readily interpret. The console must also have facilities available for the operator to rapidly and accurately respond to those situations, and changes thereto, which require operator action.

17. (C) Modes of Operation

The general purpose console uses three modes of operation, monitor, tactical, and tracking.

a. Monitor. The monitor mode requires that the console provide personnel with data which will enable them to evaluate the overall tactical situation. The display consists of radar video, track symbology which depicts friendly and enemy target positions, target threat, priority, height, track number, and other synthetic displays that depict GEOREF coordinates, area maps, and points of special interest.

b. Tactical. The tactical mode requires that the console provide operating personnel with facilities necessary for tactical supervision of the fire units. Track symbology and category selection permit the operator to distinguish between different track classifications. Relative positions of threatening tracks and fire units which are displayed on the console permit the operator to designate targets to particular fire units. Controls at the console enable the operator to issue engagement orders to the fire units.

(1) The tactical console operators are directly responsible for the tactical supervision of fire units in their respective sectors. When the tactical situation is such that the fire units are operating under decentralized control, the operator monitors the fire units under his supervision to insure correct selection of targets and effective distribution of fire. When the situation places the fire units under centralized control, the operator then designates targets to specific fire units.

(2) Specific functions of the operator are—

(*a*) Communicate air defense warnings, alert requirements, and weapon control case to the fire units under his supervision.

(*b*) Monitor tactical action to insure the engagement of hostile tracks as indicated by the correlation of battery tracking symbols with hostile track markers.

(*c*) Cease engagements and assign unengaged hostile tracks when fire unit action is not in accordance with the rules for target selection and fire distribution.

(*d*) Utilize uncommitted fire units to support the action of other fire units in the sector.

(*e*) Flag special tracks for action by remote tracking facilities.

(*f*) Make console/fire unit pairings.

c. Tracking. The tracking mode requires that the console provide operating personnel with facilities for detecting and entering new tracks into the system. It also requires that track data, such as identity, size, and height, be entered and that destroyed or lost targets be removed from the system. Manual correlation of local tracks is necessary when the criteria for automatic correlation fail to produce proper correlation.

(1) From the display of radar data and

computer-estimated track position, the operator updates tracks when necessary. The bearing of jamming signals can also be entered from the console. The operator at any time may revert to the automatic tracking mode from the RAMIT (rate-aided, manually-initiated tracking) mode, or to the RAMIT mode from the automatic tracking mode.

(2) Specific actions performed by the operator are—

(*a*) Take manual control of SAGE/BUIC tracks to correct discrepancies in position and velocity. All other data for that track remain under SAGE/BUIC control.

(*b*) Initiate RAMIT, and automatic tracking, for locally generated tracks.

(*c*) Monitor and positionally update local tracks when necessary.

(*d*) Initiate height requests and manually enter height and raid size if necessary.

(*e*) Initiate jam strobes when encountering ECM.

Section II. FUNCTIONS AND CONTROLS

18. (C) Console Functions

All general purpose consoles (fig. 6) are identical, all containing facilities for performing tracking, tactical, and monitoring functions. By means of mode switching, any console may be converted in seconds from one mode to another—tracking, tactical, monitoring, and test. Symbolic processed data plus video are displayed on a 17-inch dual-beam plan positioned indicator (PPI). The symbolic presentation is controlled by a group of category selection switches located in the upper left corner of the console front panel as shown in figure 7. Category selection is effected by selecting the desired category of data for display. Data categories are selected with alternate action pushbuttons which are lighted to indicate selection of that classification.

19. (U) Display Categories

The category selection controls on the display control panel (fig. 7) provide the operator with a wide choice of displays. Much of the flexibility is obtained through the interrelations between the identity (FRIEND, UNKNOWN, HOSTILE) and source (SAGE/BUIC, REMOTE, LOC–MAN, LOC–AUTO) controls. For example, all of the SAGE/BUIC *friendly* tracks (and *only* SAGE/BUIC *friendly* tracks) may be selected for display by pressing (lighting) the S/B *and* FRIEND (and *only* the S/B *and* FRIEND) category selection pushbuttons. Conversely, to display *all* possible remote tracks, the REMOTE, FRIEND, UNKNOWN, and HOSTILE controls must be ON (lighted). To display *all* possible hostile tracks, the HOSTILE, S/B, REMOTE, LOC–MAN, and LOC–AUTO controls must be ON. In other words, a combination of *source* and *identity* controls must be selected in order to display track symbols.

20. (U) Auxiliary Data

The auxiliary alphanumeric data associated with each track can be displayed by pressing the TRK DATA control. However, alphanumerics are displayed only for tracks that have been selected by the identity and source controls; i.e., alphanumerics will not be displayed without the presence of the track symbol on the PPI. Since hooked tracks are of special concern to the operator, the alphanumerics associated with a hooked track are always displayed on the PPI of the console that has hooked the track whether or not the console's TRK DATA control is ON and independent of the method of hooking the track.

21. (U) Common Functions

Regardless of the operational mode in which a console is being operated, monitor, tactical, or monitor tracking, certain functions as shown in table I are common to each console which can be adjusted and/or manipulated by operating personnel that will cause related changes in the console display.

a. Located on the PPI control panel at the upper right corner of the console (fig. 7) are adjustment knobs for controlling sweep, intensity, focus, and astigmatism; symbol intensity, focus, and astigmatism; range mark intensity; and

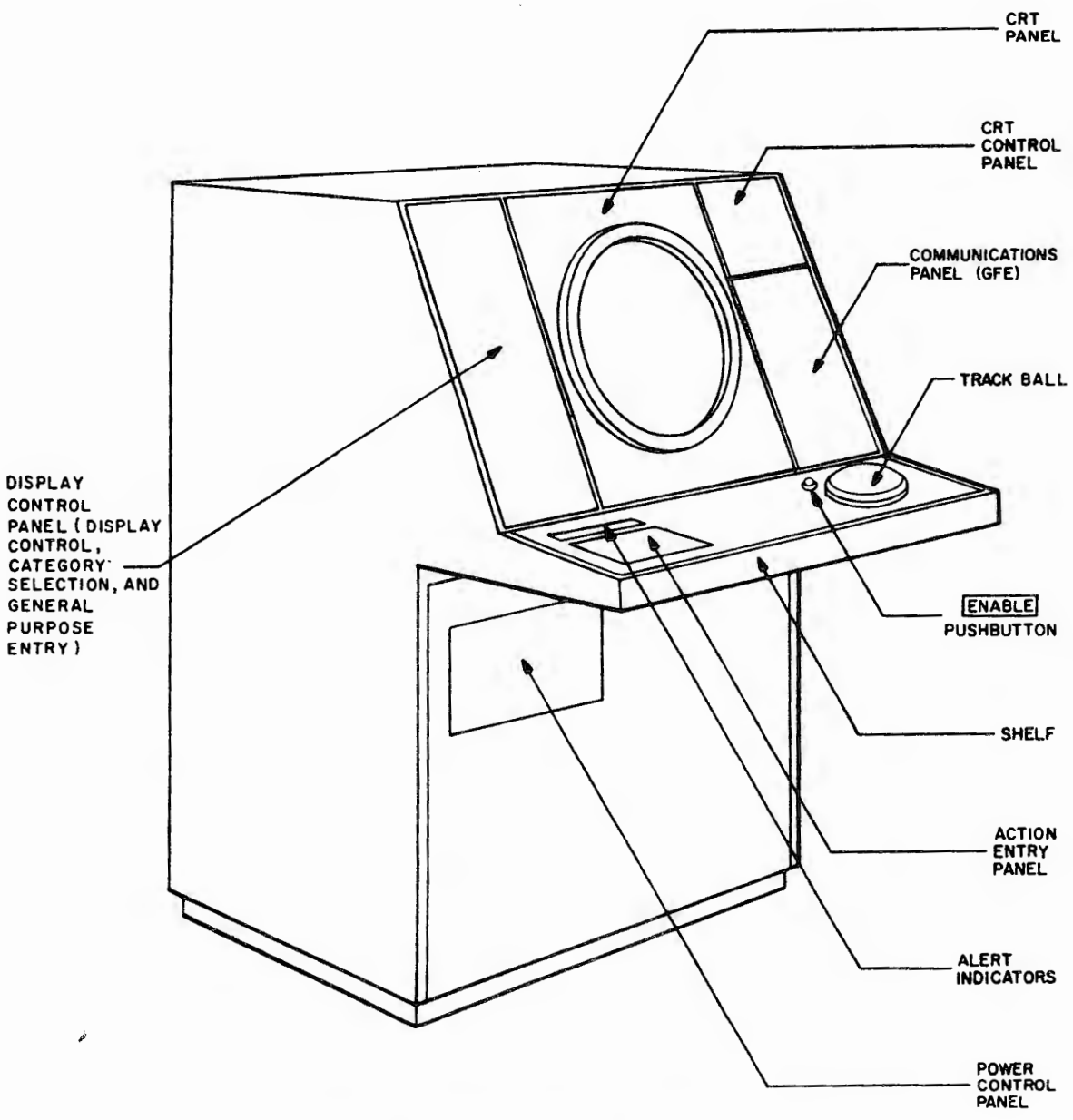


Figure 6 (U). General purpose console (U).

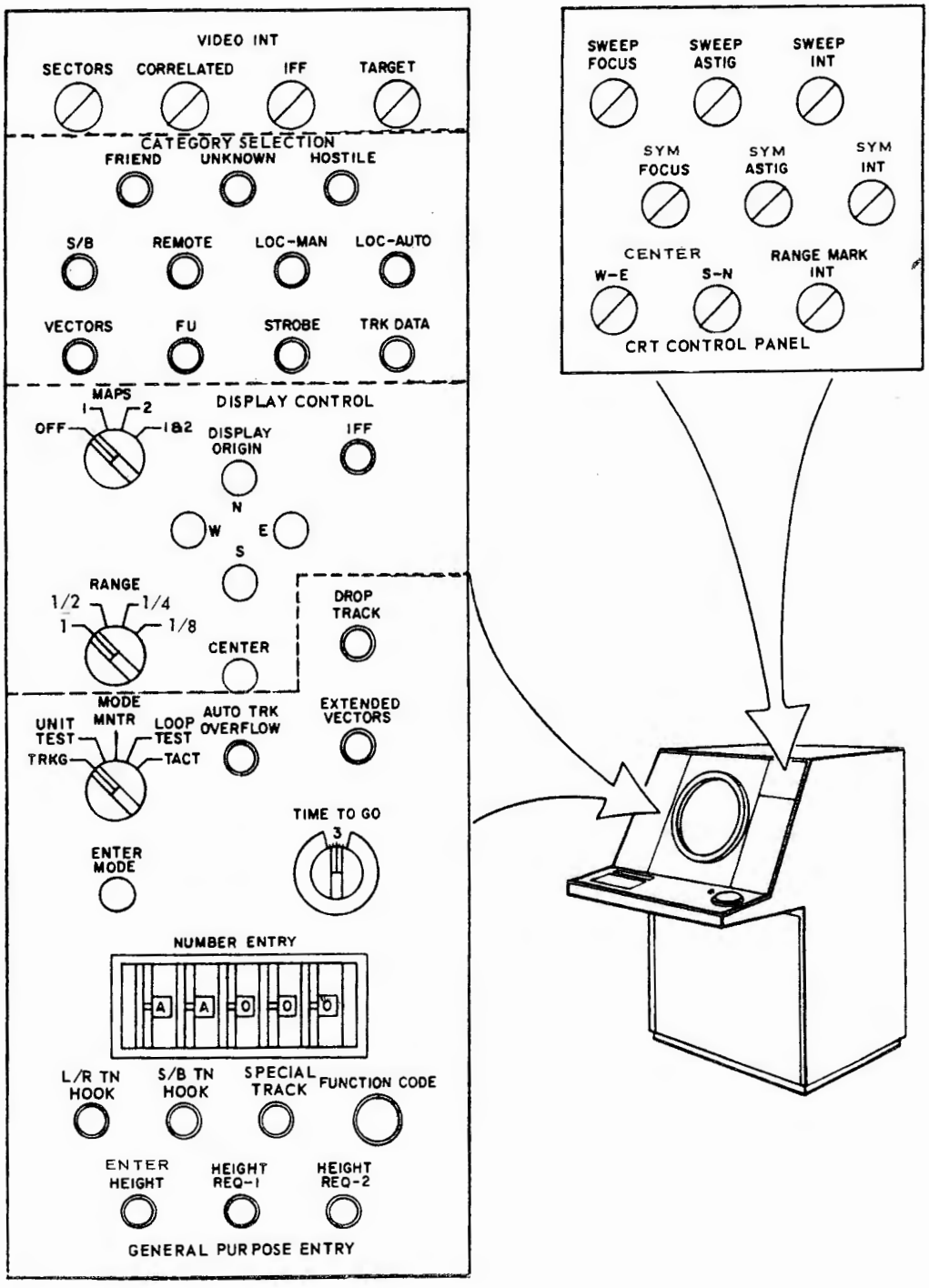


Figure 7 (U). Console display controls (U).

W–E and S–N sweep centering. Located on the display control panel at the upper left corner of the console (fig. 7) are adjustment knobs for controlling the intensity of sector, correlated, IFF, and target video returns. All of the above adjustments are considered operator type and require no special tools or equipment.

b. Also located on the display control panel at the left front (fig. 7) are pushbutton and/or rotary switches for category selection of tracks, offsetting the display from center, selection of video maps, selection of display range, display of vectors, display of fire unit symbols, display of track alphanumerics, display of jam strobes, changing the console mode of operation, and IFF challenging.

c. Table 1 lists the function(s) desired, actions required by the operator to implement those functions, the effect upon the console display; and comments related to that function.

Table 1 (C). Common Functions (U)

Function	Operator action	Console display effect	Comments
Establish video display	Set video intensities to desired level by turning SWEEP INT, TARGET VIDEO INT, IFF VIDEO INT, SECTORS VIDEO INT, and CORRELATED INT adjustment knobs.	The video displays as seen on the PPI will brighten or dim.	Intensity level controls are provided to enable the individual operator to present the PPI video displays to best viewing intensity.
Select radar range marks	Set range marks intensity to desired level by turning RANGE MARKS INT adjustment knob.	Range marks appear as concentric rings about the the radar sweep origin at the following ranges: 10, 20, 30, 40, 50, 60, 70, 80, 120, 160, 200, 240, and 280 data miles.	Range marks appear only in the radar coverage area.
Select symbol display	Set symbol display intensity to desired level by turning SYMBOL INT knob.	Symbols are displayed on PPI independent of video display.	
Center display	Set W–E CENTER and S–N CENTER controls to center the display.	The overall PPI display is geometrically centered.	The DISPLAY ORIGIN CENTER pushbutton should be pressed. *Note.* The centering controls are not used as variable offset controls.
Adjust PPI beam focus and astigmatism.	Set SWEEP FOCUS and SWEEP ASTIG controls for video display. Set SYM FOCUS and SYM ASTIG controls for symbol, lines, and map display.	PPI display is focused.	Separate FOCUS and ASTIG controls are provided for each of the two electron beams.
Display local manual tracks.	Press LOC–MAN category selection pushbutton.	LOC–MAN pushbutton is lighted and selected tracks are displayed on the PPI.	Only those tracks selected by identity (FRIENDLY, UNKNOWN, HOSTILE) will be displayed.

Table 1 (C). Common Functions (U)—Continued

Function	Operator action	Console display effect	Comments
Display local automatic tracks.	Press LOC–AUTO category selection pushbutton.	LOC–AUTO pushbutton is lighted and selected tracks are displayed on the PPI.	Only those tracks selected by identity (FRIENDLY, UNKNOWN, HOSTILE) will be displayed.
Display remote tracks	Press REMOTE category selection pushbutton.	REMOTE pushbutton is lighted and selected remote tracks when they exist in the system are displayed on the PPI.	Remote tracks are defined as those originating at an associated RRIS or AADCP. Console will display *all* tracks from associated RRIS and *only* engaged and special tracks from adjacent AADCP's. An RRIS console displays all tracks being broadcast by its parent AADCP. Tracks originated at the RRIS are not displayed as received broadcast tracks but as local tracks.
Display SAGE/BUIC tracks.	Press S/B category selection pushbutton.	S/B pushbutton is lighted, and selected SAGE/BUIC tracks, when they exist in the system, are displayed on the PPI.	Only those tracks selected by identity (FRIENDLY, HOSTILE) are displayed.
Display tracks of selected identity (FRIENDLY, UNKNOWN, HOSTILE).	Press FRIENDLY, UNKNOWN and/or HOSTILE category selection pushbutton.	FRIENDLY, UNKNOWN, and/or HOSTILE pushbuttons are lighted and only those selected tracks existing in the system will be displayed on the PPI.	Subject to REMOTE, S/B, LOC–MAN, and LOC–AUTO selections. It is possible to display all types of tracks at the same time.
Display auxiliary alphanumeric data with displayed tracks.	Press TRK DATA category selection pushbutton.	TRK DATA pushbutton is lighted and alphanumeric data are presented on the PPI with all tracks being displayed.	Track alphanumerics will appear *only* for those tracks being displayed.
Display velocity vectors	Press VECTORS category selection pushbutton.	VECTORS pushbutton is lighted and velocity vectors are displayed with all tracks that appear on the PPI.	Velocity vector scale factor is 1 inch=1,000 mph.
Display fire units	Press FU category selection pushbutton.	FU pushbutton is lighted and all fire unit site sumbols, site alphanumerics, primary designation flag, pairing lines, and fire unit tracking symbols are displayed on the PPI.	Fire units are displayed independently of track display and the alphanumerics associated with a fire unit tracking marker are displayed only when the marker is hooked.

Table 1 (C). Common Functions (U)—Continued

Function	Operator action	Console display effect	Comments
Display jam strobes	Press STROBE category selection pushbutton.	STROBE pushbutton is lighted and *all* jam strobes are displayed on the PPI.	Jam strobes are displayed independently of track display and one jam strobe per site can be displayed.
Cancel any category previously displayed.	Press any of above category selection pushbuttons.	The associated pushbutton is no longer lighted and the related display is eliminated from the PPI.	
Display maps	Turn the MAPS switch to 1, 2, or 1 and 2 position.	Preprogramed computer generated maps are displayed on the PPI.	Maps are displayed independently of track display. *Note.* To remove a map display, the console operator must turn the MAPS switch to OFF.
Display range selection	Select ⅛, ¼, ½, or 1 position by turning the RANGE switch.	The selected range corresponds to the PPI radius: ⅛=80 data miles. ¼=160 data miles. ½=320 data miles. 1=640 data miles.	
Offset the display origin location.	Press appropriate DISPLAY ORIGIN pushbutton(s), as follows: 1. CENTER to place the display origin at the PPI center. 2. N, E, S, or W, to place the display origin one radius from the PPI center at 0°, 90°, 180°, or 270°. 3. N or S, and E or W to offset the origin one radius above or below the PPI center and simultaneously one radius to the right or left of the PPI center.	Pressed pushbutton(s) become lighted and the display origin is as selected.	W and E pushbuttons are interlocked to prevent simultaneous selection. N and S pushbuttons are interlocked to prevent simultaneous selection. CENTER pushbutton is interlocked with each of the other pushbuttons to prevent simultaneous selection.
Activate IFF interrogator	Press and hold the IFF pushbutton.	If there is a response to the challenge, IFF video appears on the PPI in the vicinity of the track responding.	Site radar is requested to interrogate. All console IFF pushbuttons are connected in parallel with each other and the BEACON position of the track mode selector on the display track panel.
Establish console mode	Turn MODE switch to desired position: TRKG, MNTR, or TACT.	Action entry panel controls and indicators lamps go out.	All console entry controls are disabled.
	Press the ENTER MODE pushbutton.	Action entry panel controls and indicators for the selected mode are lighted.	The console entry controls for the selected mode are enabled.

22. (C) Tracking and Tactical Mode Functions

a. In addition to the controls and functions discussed in paragraphs 19 through 21, located on the console display control panel are other controls and functions peculiar to the tracking and tactical modes of operation (but not to the monitor mode) which provide operating personnel with the means of requesting height information on tracks, displaying extended vectors with-variable time, hooking tracks (gaining close control), dropping tracks, flagging tracks as special, and entering alphanumerics through the use of a number entry dial.

b. Table 2 lists the functions desired, actions by the operator to implement those functions, the effect upon the console display if applicable, and comments related to that function.

Table 2 (C). Tracking and Tactical Mode Functions (U)

Function	Operator action	Console display effect	Comments
Drop track	Press DROP TRACK pushbutton.	Symbology for the hooked track disappears from the PPI.	Causes a local track that is hooked by the console to be dropped from the local track store. Causes a remote track that is hooked by the console to change to a SPECIAL, type "D." A drop track request is transmitted to the remote sites. If the hooked track is from SAGE/BUIC, a drop track request is transmitted to SAGE/BUIC where it is automatically honored.
Height request No. 1	Press HEIGHT REQ–1 pushbutton.	----------	(Track must be previously hooked.) When pressed, causes the data processor to transmit a height request message concerning the hooked track to height-finder radar No. 1.
Height request No. 2	Press HEIGHT REQ–2 pushbutton.	----------	Same as HEIGHT REQ–1, except message is transmitted to height-finder radar No. 2.
Special track	Press SPECIAL TRACK pushbutton.	----------	(Track must be previously hooked.) If the hooked track is a special track, pressing the SPECIAL TRACK pushbutton will return the track to normal classification. If the hooked track is not a special track, pressing the SPECIAL TRACK pushbutton will make it special, with its type (A, B, C) being determined by the setting of the first letter dial of the number entry dials. (Types of special tracks will be controlled by SOP.)

Table 2 (C). Tracking and Tactical Mode Functions (U)—Continued

Function	Operator action	Console display effect	Comments
Extended vectors and time to go.	Press EXTENDED VECTORS pushbutton and turn TIME TO GO dial to desired time.	----------	(Track must be previously hooked.) When pressed, the EXTENDED VECTORS pushbutton causes an adjustable vector to be displayed with its origin at the hooked track. The terminus of the vector is the extrapolated position of the track after the selected time elapse. The time elapse is selected with the TIME TO GO dial, and is selectable in increments of ¼ minute between 0 and 4 minutes, and in increments of ½ minute between 4 and 8 minutes.
L/R TN hook----------	Press L/R TN HOOK pushbutton.	----------	When pressed, the console becomes hooked to the track (local or remote) whose track number is set into the NUMBER ENTRY dials (one letter and two digits).
S/B TN hook----------	Press S/B TN HOOK pushbutton.	----------	When pressed, the console becomes hooked to the SAGE/BUIC track whose track number is set into the NUMBER ENTRY dials (two letters and two digits or one letter and three digits).
Height----------	Press HEIGHT pushbutton.	----------	(Track must be local and previously hooked.) When pressed, the height (set into the three digit dials of the NUMBER ENTRY dials) is entered into the data processor and associated with the hooked track.
Function code----------	Press FUNCTION CODE pushbutton.	----------	When pressed, the octal numbers set into the two rightmost digit dials of the NUMBER ENTRY dials are transmitted to the computer as a function code.
Number entry----------	----------	----------	See comments for SPECIAL, L/R, S/B TN HOOK, HEIGHT, and FUNCTION CODE functions.

23. (C) Action Entry Functions

Located on the left side of the operator's shelf of the general purpose console is an action entry panel with pushbutton controls used by the operator in the tracking mode to establish new tracks, call up the video tab, enter identity and raid size, switch from manual to automatic tracking, update track position, enter and erase sectors, transfer control of SAGE/BUIC tracks, and enter jam strobes. In the tactical mode the operator, through the use of applicable action entry controls, can couple the console to a fire unit, cause commands to be sent to a fire unit, reference tracks, gain close control over a fire unit, and establish pairing lines between fire units and tracks.

a. Common to both tracking and tactical modes of operation are action entry controls for calling up the symbol tab, hooking tracks, and sequencing to tracks.

b. Each of the entry controls are of momentary action pushbutton type and each has associated with it a label which is backlighted only when the console is placed in the operational mode which uses those controls peculiar to that mode.

c. The functions used in the tracking mode, as labeled on the pushbutton (fig. 8), are SINGLE, FEW, MANY, FRIENDLY, UNKNOWN, HOSTILE, AUTO/MANUAL, LOCAL ENABLE, ENTER, SECTOR, ERASE SECTOR, JAM STROBE, SYMBOL TAB, POS HOOK, TRACK UPDATE, SEQ HOOK, NEW TRACK, and VIDEO TAB.

d. The functions used in the tactical mode, as labeled on the pushbutton (fig. 9), are FU HOOK, BOOKKEEP PAIR, ENGAGE TRACK, CEASE ENGAGE, HOLD FIRE, SYMBOL TAB, POS HOOK, FU TO CONSOLE, SEQ HOOK, and REF TRACK.

e. The monitor mode uses none of the action entry controls, therefore the functions and labels on the action entry panel are inhibited and no lighting takes place.

f. There are means also available to place a console in a test mode (UNIT TEST or LOOP TEST) used by maintenance personnel in performing routine maintenance and troubleshooting procedures.

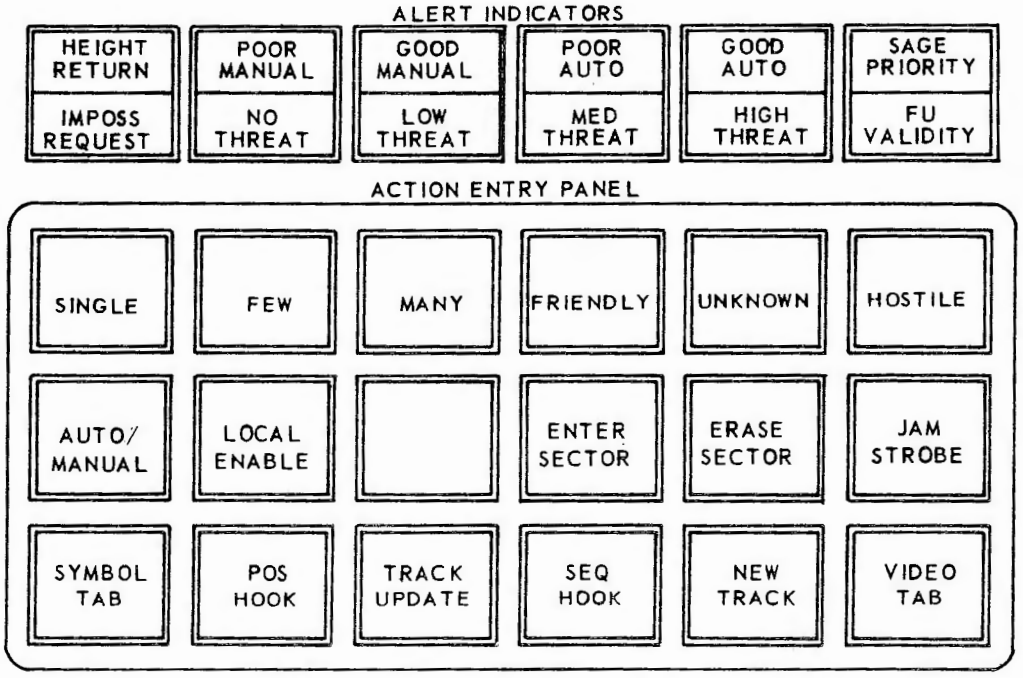


Figure 8 (U). Action entry panel (tracking mode) (U).

g. Table 3 lists the action entry controls and the utilization of those functions when operating a console in the tracking mode.

h. Table 4 lists the action entry controls and the utilization of those functions when operating a console in the tactical mode.

Table 3 (C). Action Entry Functions (Tracking Mode) (U)

Pushbutton indicator	Function
SINGLE, FEW, MANY	Allow manual entry of raid size for a hooked local track.
FRIENDLY, UNKNOWN, HOSTILE.	Allow manual entry of identity for a hooked local track.
AUTO/MANUAL	Selects mode of tracking, automatic or rate-aided, manually initiated tracking (RAMIT) for a hooked local track.
LOCAL ENABLE	Transfers tracking control for a hooked SAGE/BUIC track to local for RAMIT. Returns tracking control of a hooked track to SAGE/BUIC by second operation.
ENTER SECTOR	When pressed, enters coordinates of a boundary for a dark target area. Two entries are required to define an area.
ERASE SECTOR	When pressed, removes codinates of boundary for a dark target area. Two operations are required to define the dark target area to be erased.
JAM STROBE	Works with track ball and video tab to enter bearing angle of the jamming track.
SYMBOL TAB	When pressed, causes symbol tab to appear at center of display.
POS HOOK	Used with the track ball and the symbol tab to gain close control of a selected track by its position.
TRACK UPDATE	Transfers a hooked manual local or locally controlled SAGE/BUIC track to the position indicated by the operator-controlled marker.
SEQ HOOK	Used to gain close control of the next track on the tracking assignment list.
NEW TRACK	When pressed, coordinates of the video tab are entered as those of a newly acquired track.
VIDEO TAB	When pressed, causes the video tab to appear at the display origin.

Table 4 (C). Action Entry Functions (Tactical Mode) (U)

Control pushbutton indicators	Function
FU HOOK	Used with the track ball and symbol tab to hook a fire unit site Mark or tracking marker to the console.
BOOKKEEP PAIR	Used to pair a console with a fire unit track for AADCP monitoring without designating.
ENGAGE TRACK	Used to order a fire unit to engage a track.
CEASE ENGAGE	Used to order a fire unit to cease engaging a track.
HOLD FIRE	Used to order all fire units paired with a track to hold fire on that track.
SYMBOL TAB	When pressed, causes the symbol tab to appear at the center of the display.
POS HOOK	Used with the track ball and the symbol tab to gain close control of a selected track by its position.
FU TO CONSOLE	Used with the track ball and symbol tab to couple a fire unit to a console.
SEQ HOOK	Used to gain close control of the next track in the tactical sequence set.
REF TRACK	Used with the track ball and symbol tab to reference friendly or hostile tracks to all fire units.

i. Alert indicator lamps, which light when activated, alert the console operator to existing conditions that could materially affect the battle situ-

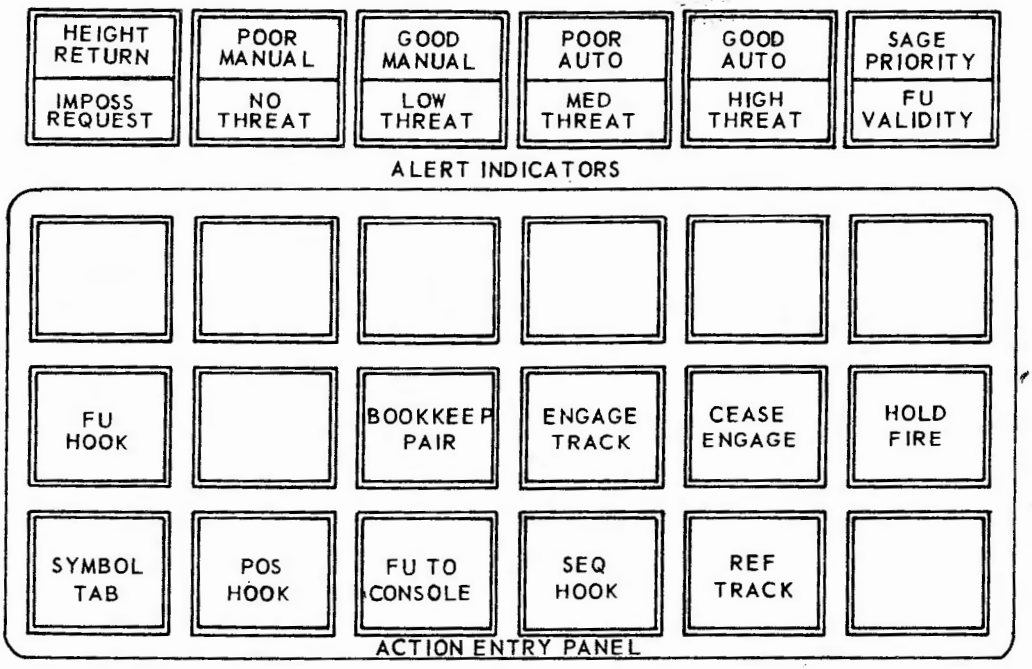


Figure 9 (U). Action entry panel (tactical mode) (U).

ation. On the operator's shelf of the console and just above the action entry controls are 12 alert indicator lamps which, when lit, inform the operator that action is required by the operator to relieve the circumstances or situations which caused them to light.

j. The alert indicators described above are utilized in the tracking and tactical modes but not in the monitor mode.

k. Located on the display control panel on the left side of the console is an alert indicator lamp labeled, AUTO TRACK OVERFLOW, which can be activated in any of the three console operational modes.

l. Table 5 lists the alert indicator lamps and tells the operator the meaning of the alert indication.

Table 5 (C). Alert Indications (U)

Alert indicator	Meaning
AUTO TRK OVERFLOW (on display control panel).	Indicates that clutter is degrading (saturating) the automatic tracking function in the data processor.

Table 5 (C). Alert Indications (U)—Continued

Alert indicator	Meaning
HEIGHT RETURN	Indicates that height has been determined by height-finder radar.
IMPOSS REQUEST	Indicates that operator has attempted to perform an invalid operation.
POOR MANUAL	Indicates tracking mode and quality.
GOOD MANUAL	Do.
POOR AUTO	Do.
GOOD AUTO	Do.
SAGE PRIORITY	Indicates that SAGE/BUIC has sent a HOLD FIRE message concerning this track.
NO THREAT	Indicates the threat evaluation as determined by the data processor.
LOW THREAT	Do.
MED THREAT	Do.
HIGH THREAT	Do.
FU VALIDITY	Indicates that the fire unit tracking marker has a "validity bit" associated with it. (The validity designation is entered by the fire unit as determined by SOP.)

CHAPTER 5 (C)

AADCP EQUIPMENT DISPLAYS (U)

24. (U) General

The AADCP equipment provides operating personnel not only with video on the PPI, but also generates symbology associated with tracks and fire units. It has the means of displaying the status of the fire units in the defense. A manual plotting board is provided for plotting early warning data and target position during manual AADCP operation.

25. (C) Symbology

a. In addition to numbers and letters being displayed on the PPI, other symbols and markers are generated and presented which assist the console operator in evaluating the battle picture.

b. The dimensions of the symbols and/or markers are of definite significance and through a knowledge of their size and shape the operator can more readily interpret the information being displayed.

c. Figure 10 portrays those letters and numbers used in the console display. The characters as shown are ideal but may not so appear due to electronic effects within the display system. An alphanumeric is defined as a group containing both letters and numbers.

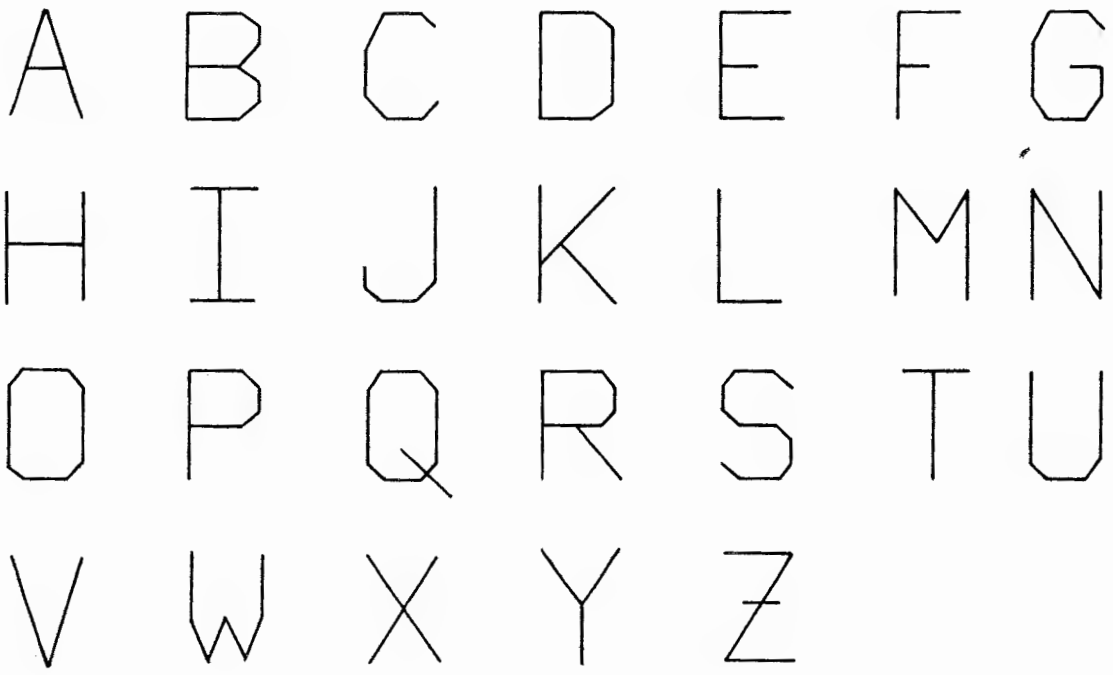
d. Figures 11 and 12 portray the symbols and markers used to identify the source and identity of tracks, location of fire units, fire unit tracking, tracks designated as special, video and symbol ball tab symbols, hook symbol, simulated video, and local simulated track marker.

(1) Note in figure 11 that the marker used for unknown tracks is U-shaped and that through the absence of a horizontal or vertical bar appearing within the marker, it is readily identified as being a local-unknown. A friendly marker appears as a circle and a hostile marker appears as a diamond.

(2) Except for SAGE/BUIC markers, which are ⅛-inch in size and indicate only friendly or hostile, all other markers, local or remote, are ¼-inch in size. Tracks not initiated locally will always have a horizontal bar appearing within the marker, and, if the track has been referenced, a vertical bar will appear. It must be noted from the bottom line of the figure that it is possible to have both a horizontal bar and a vertical bar in a marker. Only those tracks, friendly or hostile, which have been referenced are transmitted to the fire units from the AADCP. Referencing a track means that it is placed in the communications channels for transmission to fire units. Friendly and hostile tracks are exchanged between the AN/TSQ–51 and SAGE/BUIC without referencing. Unknown, friendly, and hostile tracks, and jam strobes are exchanged between the AN/TSQ–51 and other remote facilities without referencing.

(3) The symbols and markers shown in figure 12 vary in size: 1/16-inch for the fire unit site marker and simulated video marker; ⅛-inch for the symbol ball tab and video ball tab; ¼-inch for the local simulated, special, and fire unit tracking markers; and ½-inch for the hook symbol.

e. Figure 13 shows the location of each alphanumeric with respect to each other alphanumeric within the area taken up by the symbology used with one tract or fire unit location. The area occupied with any track or fire unit location is called the field and the distance from the center of one character or marker to the center of another is fixed as indicated in the figure.



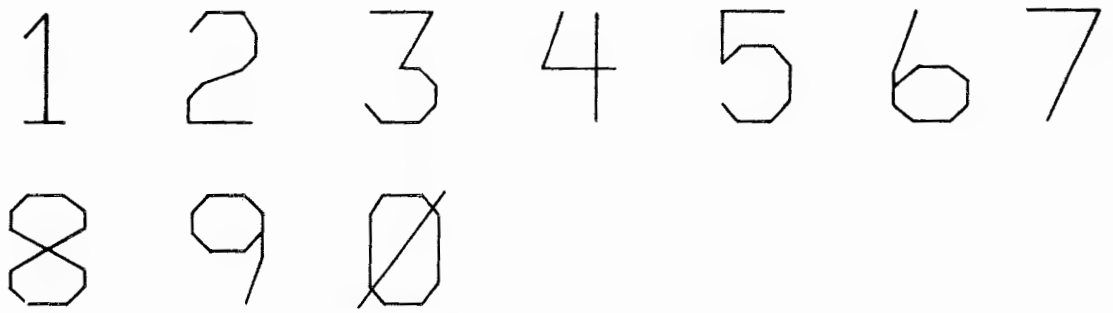


Figure 10 (U). Console display alphanumerics (U).

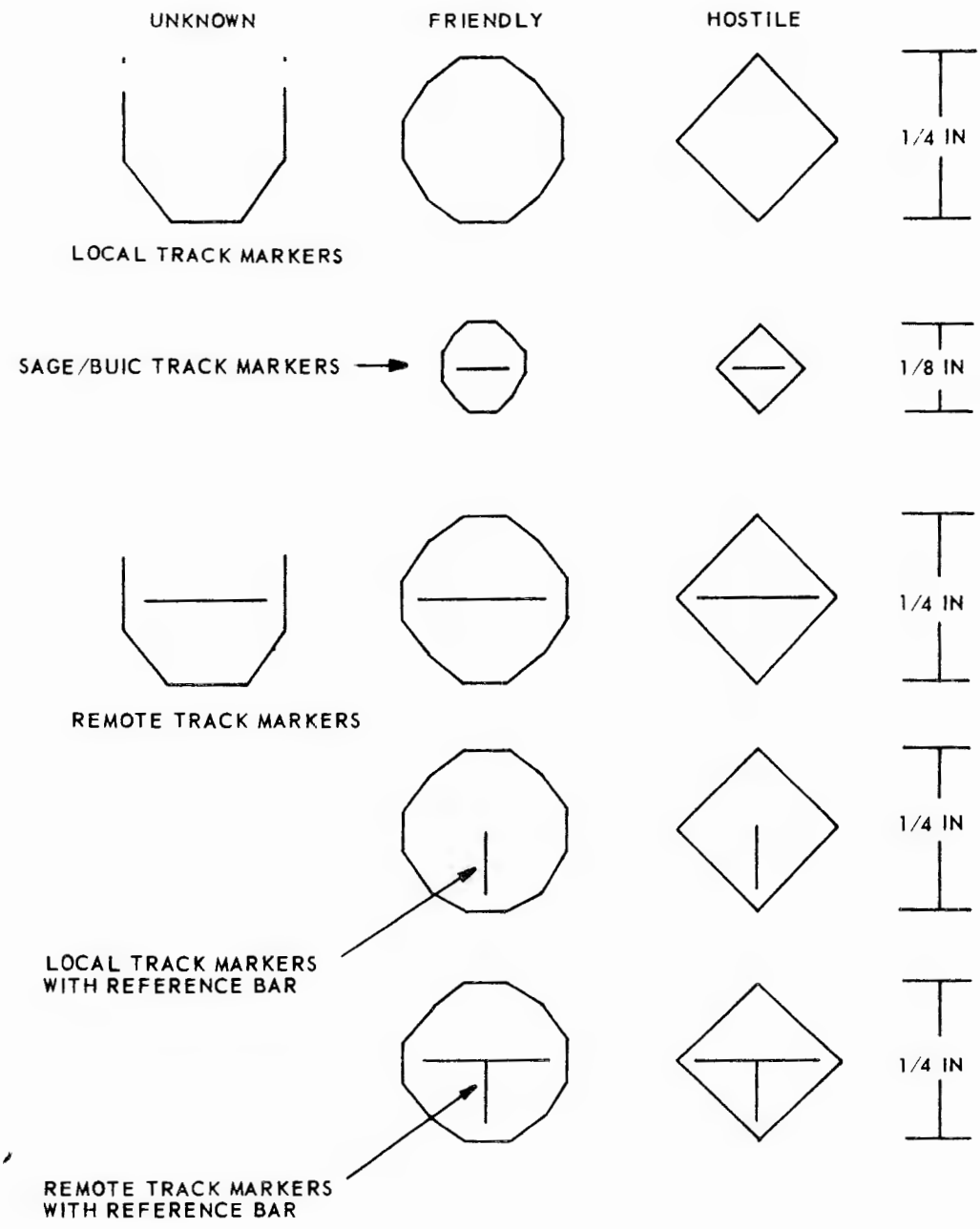


Figure 11 (U). Markers and symbols (U).

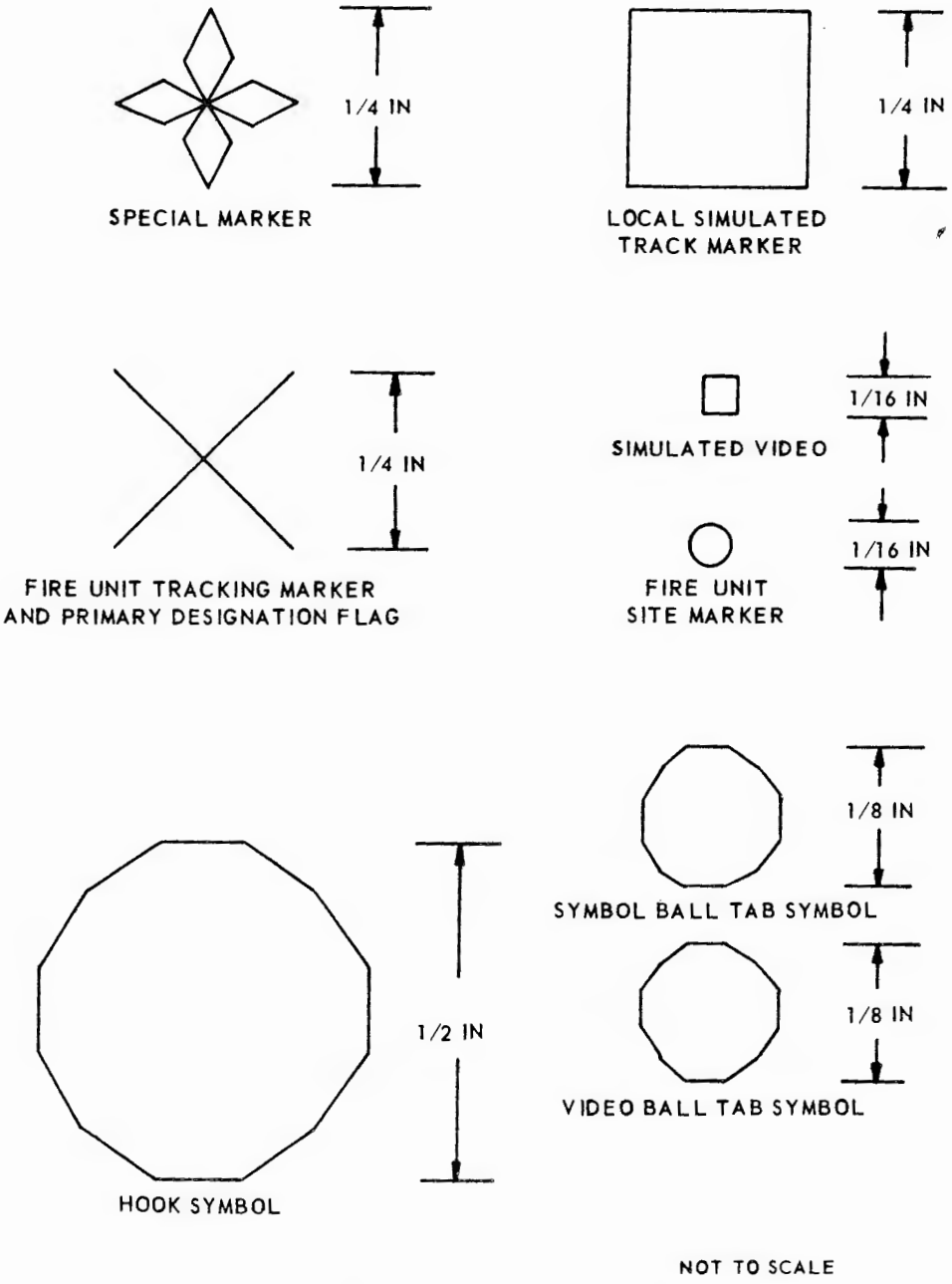


Figure 12 (U). Markers and symbols (U).

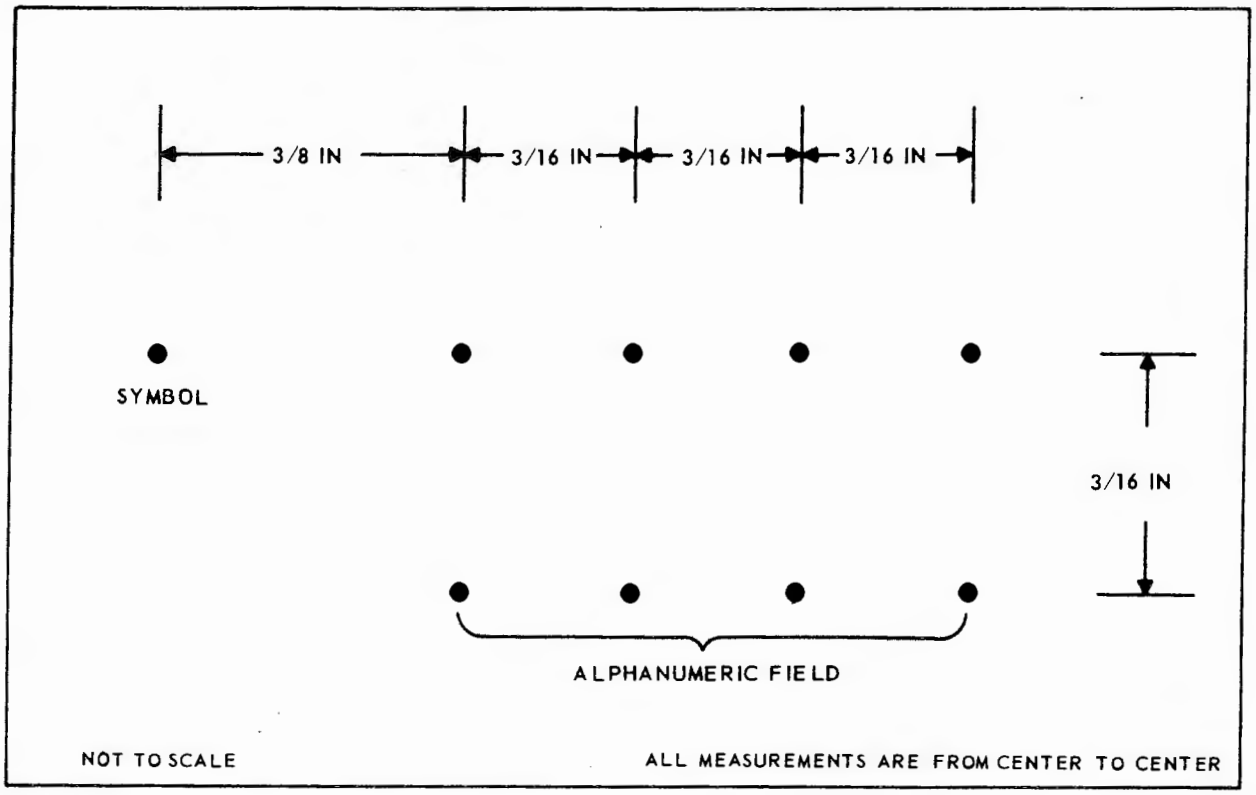


Figure 13 (U). Symbology and alphanumeric field presentation (U).

f. Any console alphanumeric track display will always contain a marker and eight letters or numbers. The top line, from left to right, contains a marker, the size and shape of which represents the source and identity, whether or not it is a local simulated track marker, track number, and tracking mode (automatic or manual (only if the track is local)). The bottom line always contains four alphanumerics. From left to right they indicate height in thousands of feet (3 digits) and raid size.

g. Because many combinations of markers and alphanumerics are possible, a breakdown of the several combinations is explained in (1) through (8) below.

(1) Figure 14 shows by the readout of the top line that the track, reading from left to right is a friendly (first character), local (second character), assigned the number 16 (third and fourth characters), and that is it being tracked in the manual tracking mode (fifth character). As explained in *f* above, the bottom line, from left to right, contains the height and raid size alphanumerics. The first three characters represent height of 23,000 feet while raid size, as indicated by the fourth character, is few (F). Because the bottom line alphanumerics for a track always contain height and raid size, this explanation will not be repeated.

(2) Figure 15 shows by the readout of the top line that the track has been designated as special (first character), local (second character), assigned the number 16 (third and fourth characters), and that it is a special type B. Special designations will be determined by local SOP.

(3) Figure 16 shows the track to be a remote friendly (first character), that it was originated at remote facility D (second character), assigned the number 48 (third and fourth characters), and that it has not been engaged, N (fifth character). Any remote track will always identify the source by the second character in the top line being A, B, C, D, or E.

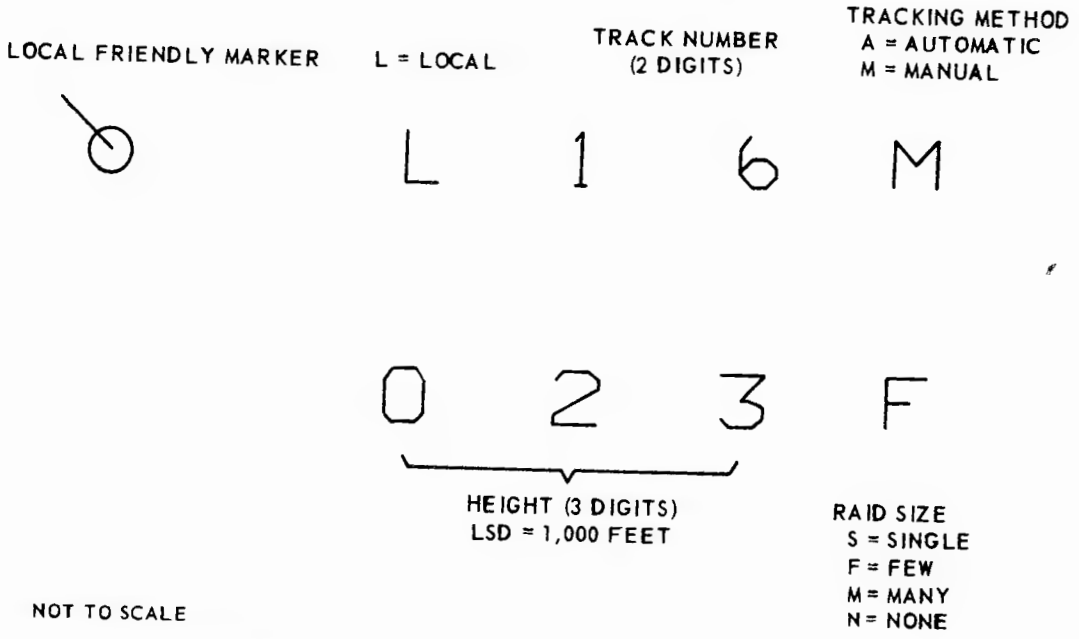


Figure 14 (C). Local friendly track with auxiliary alphanumeric readout (U).

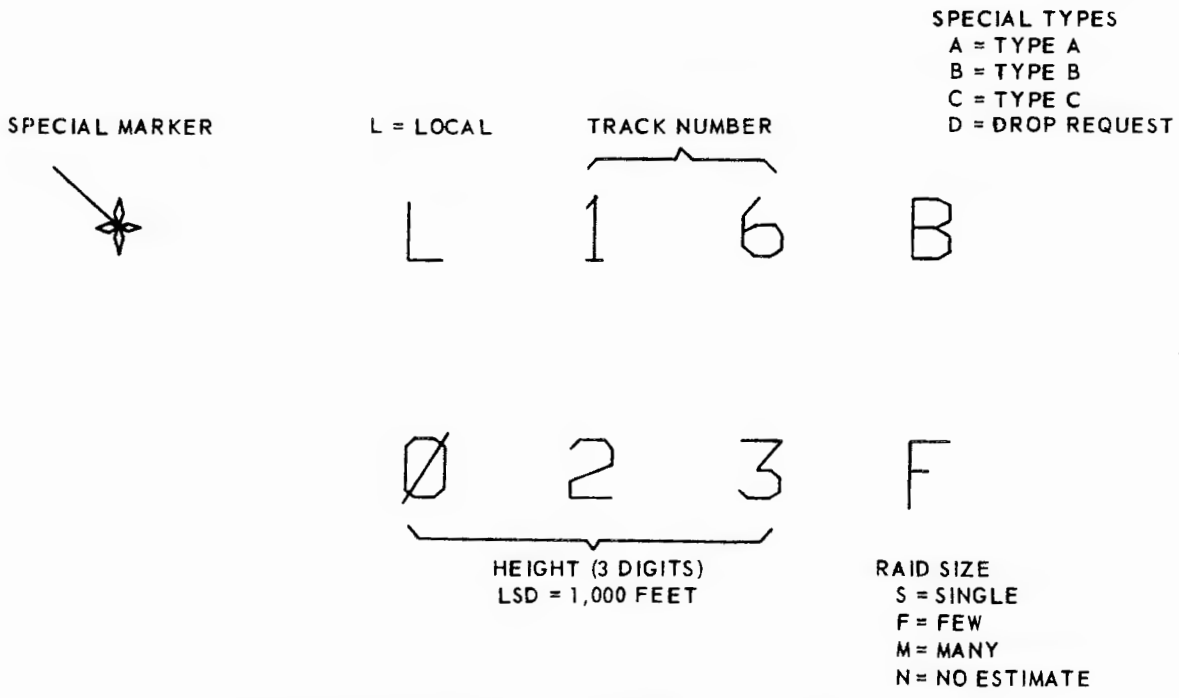


Figure 15 (C). Local special track with auxiliary alphanumeric readout (U).

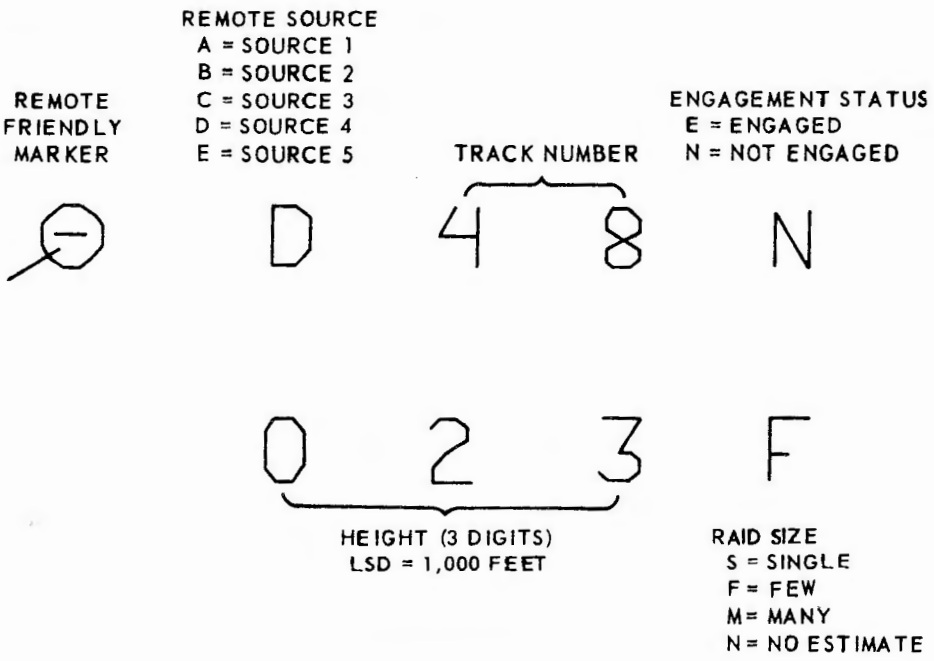


Figure 16 (C). Associated RRIS remote friendly track with auxiliary alphanumeric readout (U).

(4) Figure 17 shows the track to be special (first character), originated at remote facility D (second character), assigned track number 48 (third and fourth characters), and is a special type B (fifth character).

(5) Figure 18 shows a change in the top row of the readout. The first character, SAGE/BUIC friendly marker, is reduced in size. The second and third characters are the letters N and M, while the fourth and fifth characters are numbers (4 and 4). A SAGE/BUIC track number could also be one letter and three numbers; this would depend upon track number assignment within the SAGE/BUIC system. The tracking mode for a track from this source has no significant effect in the AN/TSQ–51 system because updating of position information is accomplished at the source. If the identity of the track is changed, the only change appearing in the top line of the readout would be a change in the shape of the marker (first character). All alphanumerics remain unchanged.

(6) Figure 19 shows by the change in the size and shape of the first character that the track appears to be a local friendly, but examination of the second through the fifth characters (NM 44) tell the operator that because a number appears as the fifth character, this is a SAGE/BUIC originated track. Local tracks will always have an A or M for the fifth character (denoting tracking mode), while a remote track will always have an E or N (denoting engaged or not engaged). This situation would arise whenever a console operator takes a SAGE/BUIC initiated track under close control to correct the track coordinates with respect to target video when, through observation of the PPI, he determines that there is too much separation between the track marker and the target video.

(7) Figure 20 shows by the top line readout that the track is local (first character), it is simulated (second character) as denoted by the letter S, assigned the track number 1 (third and fourth characters), and that it is being tracked

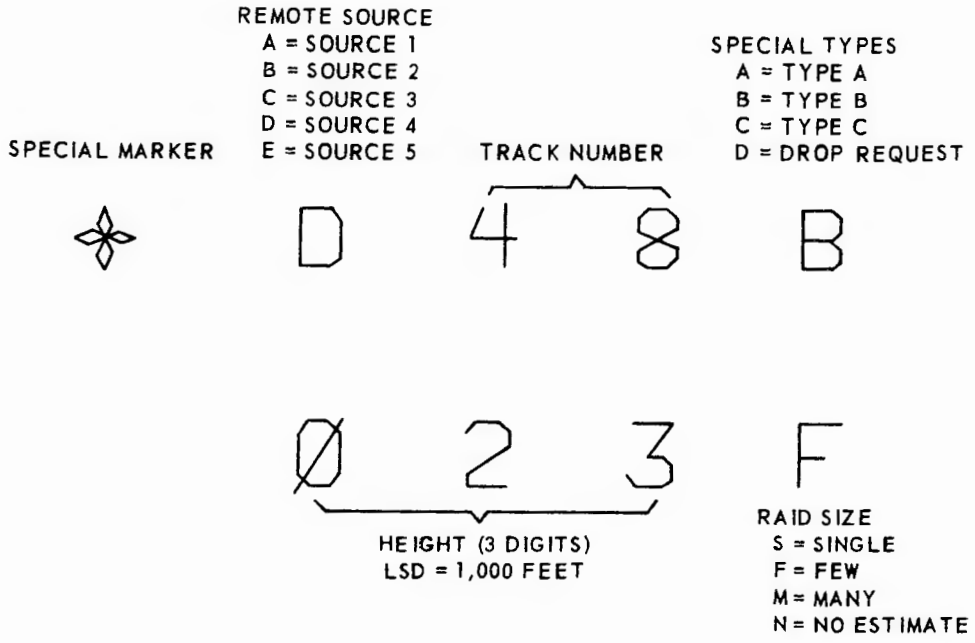


Figure 17 (C). Associated RRIS or adjacent AADCP remote special track with auxiliary alphanumeric readout (U).

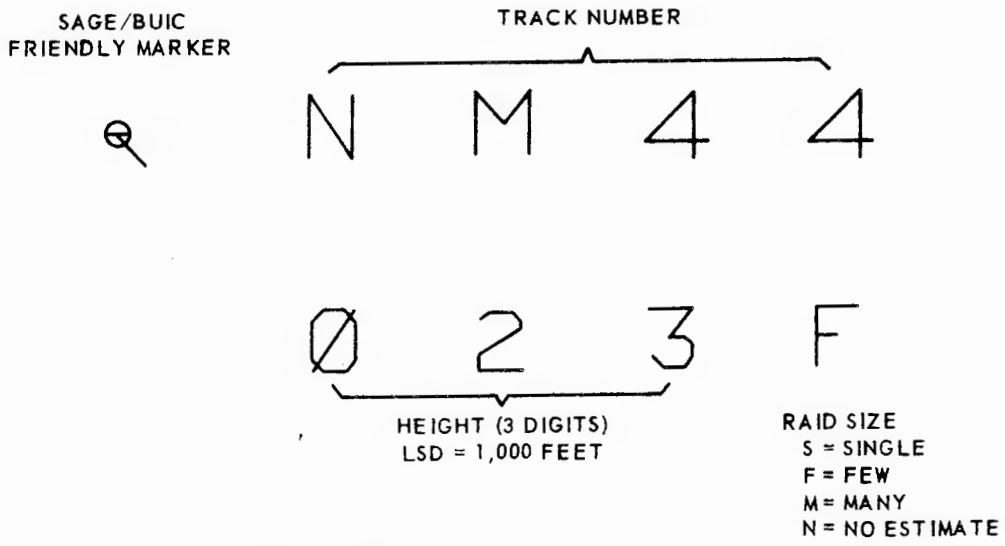


Figure 18 (C). SAGE/BUIC friendly track with auxiliary alphanumeric readout (U).

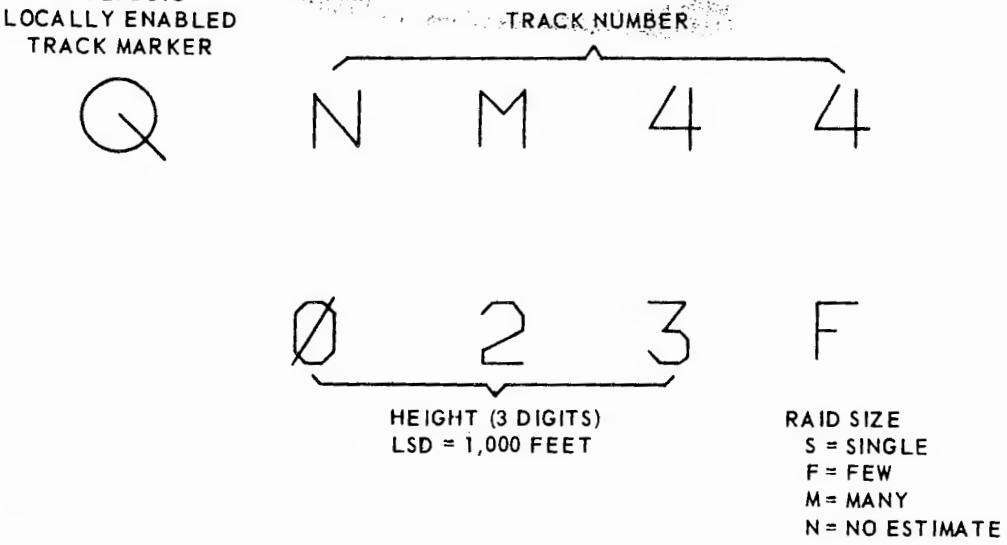


Figure 19 (C). SAGE/BUIC friendly locally enabled track with auxiliary alphanumeric readout (U).

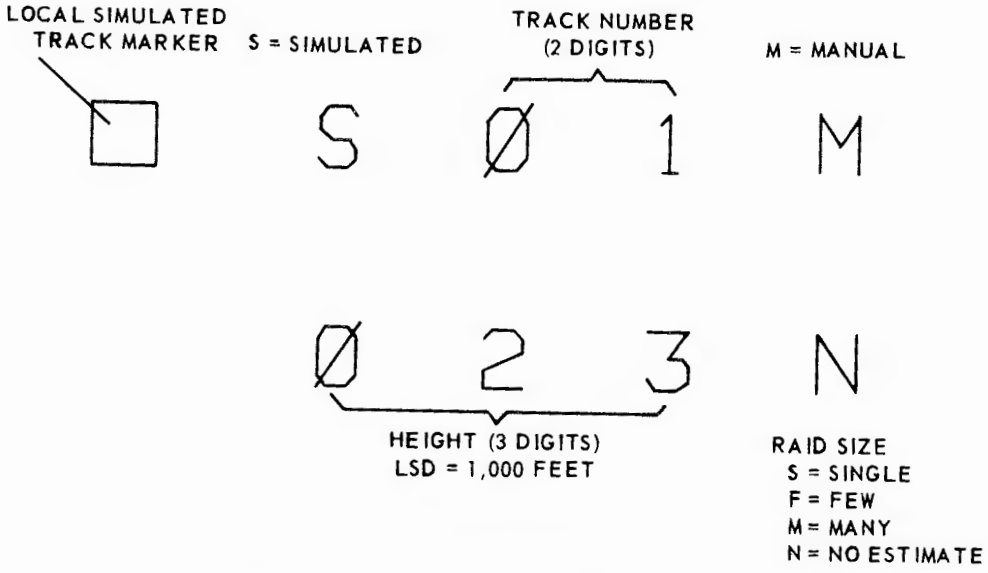


Figure 20 (C). Local simulated track with auxiliary alphanumeric readout (U).

manually (fifth character). This display appears whenever a console operator has activated the simulated video dot and is using the console and its controls for training or test purposes. An explanation of the simulated video dot and its function is contained in paragraph 32*d*.

(8) Figure 21 shows that the only difference between a SAGE/BUIC simulated track and a SAGE/BUIC normal track is the appearance of the letter Z as the fourth character in the bottom row, denoting that it is a SAGE/BOIC simulated track. No raid size is assigned to a

SAGE/BUIC simulated track. All other symbols remain unchanged. As with a local simulated track, the SAGE/BUIC simulated track is used for training and test purposes.

h. If the track being displayed is a fire unit track (initiated at a fire unit), the content of the top line is changed. Figure 22 shows in the top line readout that the first character is an X which represents a fire unit tracking marker, the second and third characters (F and U) represent the fire unit, and the fourth and fifth characters (12) indicate the numerical designation of the fire unit. The bottom line readout (height and raid size) is the same as that explained for tracks in *f* above.

i. A fire unit site marker, which represents the location of a unit, and its associated alphanumerics differ from a track marker in that its position remains fixed (established by coordinates set into the AADCP computer) and information contained in the alphanumeric readout is different. Figure 23

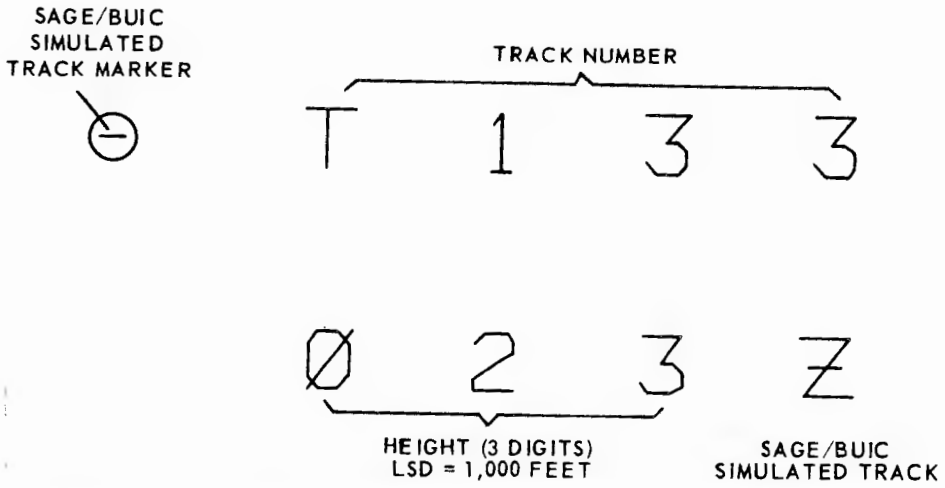


Figure 21 (C). SAGE/BUIC friendly simulated track with auxiliary alphanumeric readout (U).

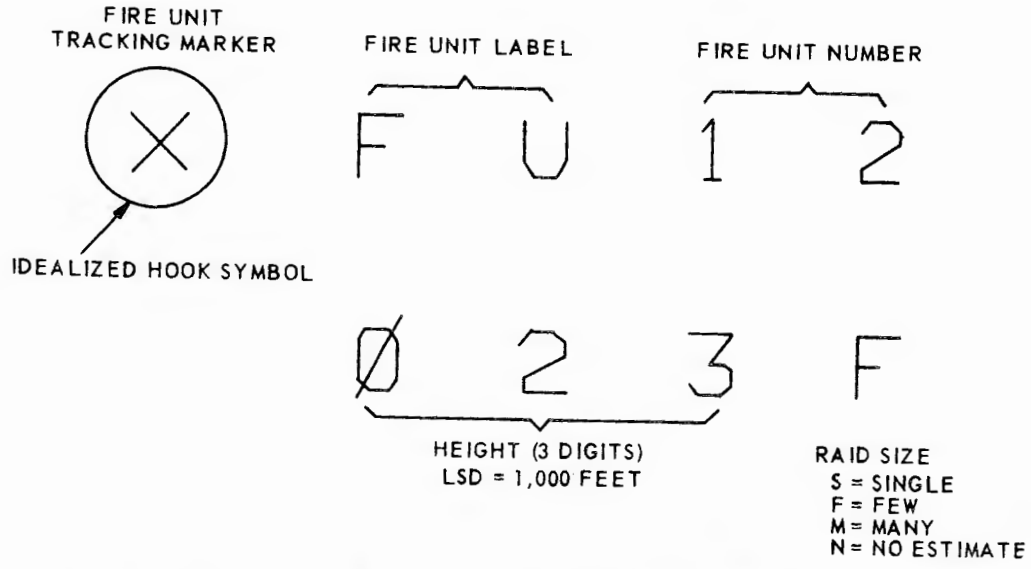


Figure 22 (C). Fire unit tracking marker with auxiliary alphanumeric readout (U).

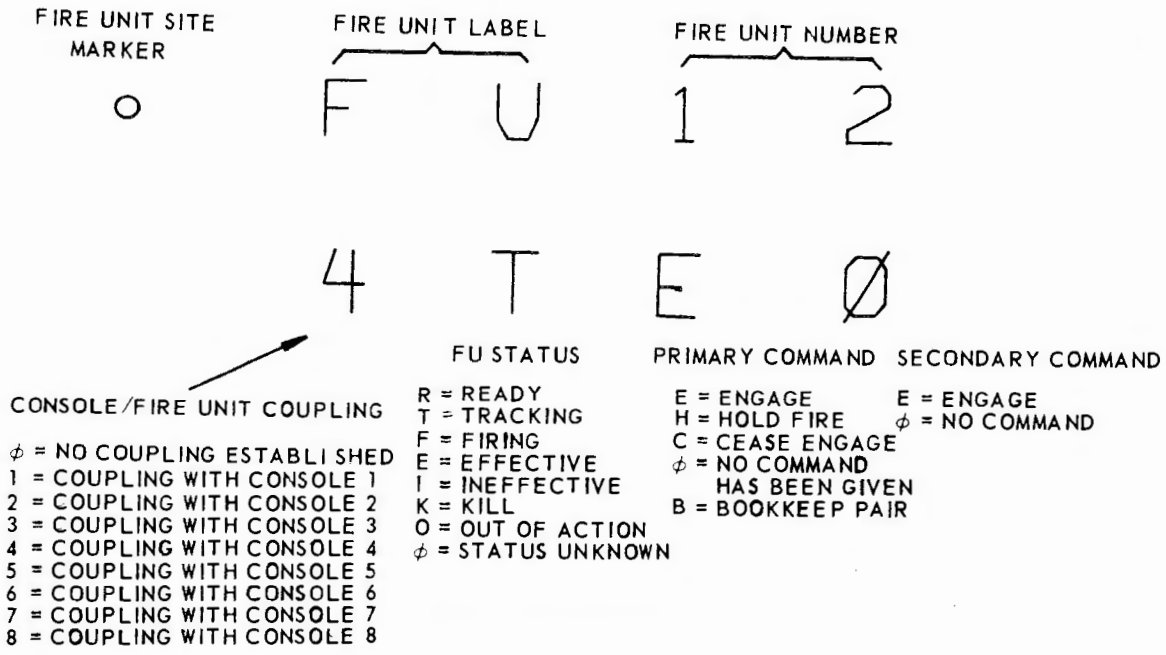


Figure 23 (U). Fire unit with auxiliary alphanumeric readout (U).

shows in the top line readout the fire unit site marker (first character), the fire unit label (second and third characters), and the fire unit number (fourth and fifth characters). The bottom line readout shows the console with which the fire unit is paired (first character), the fire unit status (second character), the primary command (third character), and the secondary command (fourth character). Note from examination of the figure that it is possible to couple a fire unit to any one of eight consoles (but only one console at a time), that the fire unit status can be any one of eight conditions: READY, TRACKING, FIRING, EFFECTIVE, INEFFECTIVE, KILL, OUT OF ACTION, or UNKNOWN, and that the commands can be any one of four: ENGAGE, HOLD FIRE, CEASE ENGAGE, or NO COMMAND.

j. Figure 24 shows the symbology and alphanumerics displayed on the PPI of a console being operated in the tactical mode and involved in designating a fire-unit-initiated track directly back to that fire unit. The upper alphanumeric readout shows a hooked track marker over a hostile symbol with the fire unit label accompanying the marker along with height and raid size. The lower readout shows the site symbol, fire unit label, console coupling (console No. 4), fire unit tracking, primary assignment of ENGAGE, and no secondary assignment.

26. (C) General Purpose Console Presentations

a. Raw radar video is obtained from the collocated radar and processed by electronic circuits in the equipment trailer before being sent by cable to the operations trailer for display on the general purpose consoles. This processing is necessary in the AN/TSQ–51 system because of the availability of two automatic-track-while-scan processes. One process uses skin video (video obtained as a result of RF energy reflected from the surface of an object while the other process uses beacon video (video obtained from a signal, the transmission of which is initiated by the IFF equipment). Thus the video obtained from these processes is called target video and beacon video. All video appears on the PPI as areas which brighten whenever the radar sweep passes the area from where the signal is obtained. This brightness can be controlled by the console operator using related controls.

b. Correlated video, another type of video, is available if the console operator desires to use it. When a target is being tracked automatically it is

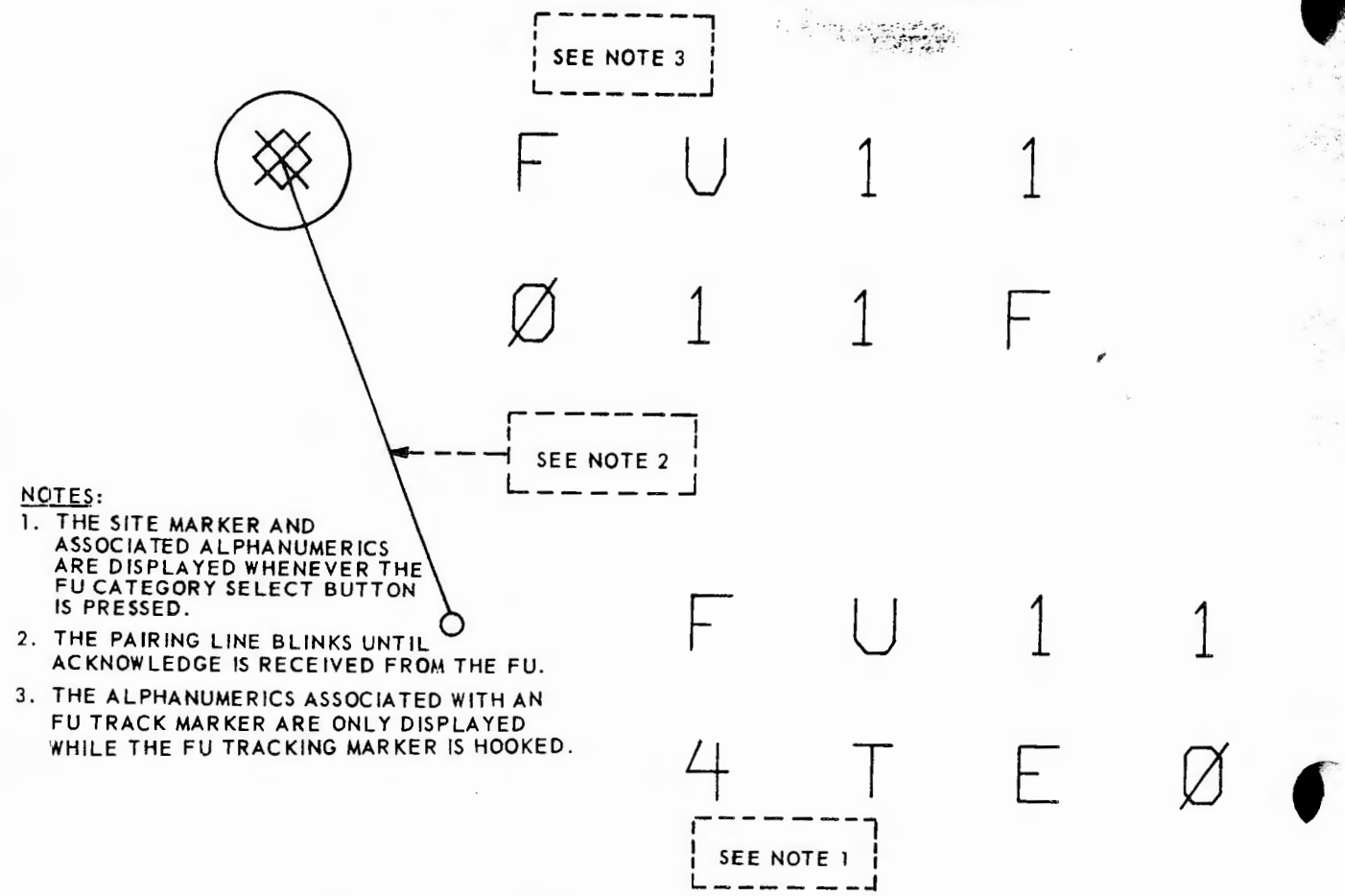


Figure 24 (U). Tactical mode display, fire-unit-initiated track (U).

possible to display not only the processed target video but also correlated video which results from additional processing that filters the video by removing any clutter or noise signals. This additional processing causes the display of the correlated video to be delayed so that it is presented on the PPI approximately 3,000 yards in range and 0.5° in azimuth from the original target video. Correlated video is always available as is target video; however, only when the operator adjusts the intensity of either or both will they be displayed.

c. When the noise and clutter filtering efforts of the radar receiver or the AADCP video processor are insufficient to bring the noise or clutter down to a manageable level, the AN/TQS–51 system provides another means of clutter rejection—inhibited sectors. These sectors (also called "dark target" areas) are operator-entered PPI areas within which automatic tracking is not performed. Established automatic tracks entering such areas are maintained by computer straight-line extrapolation until the target leaves the area.

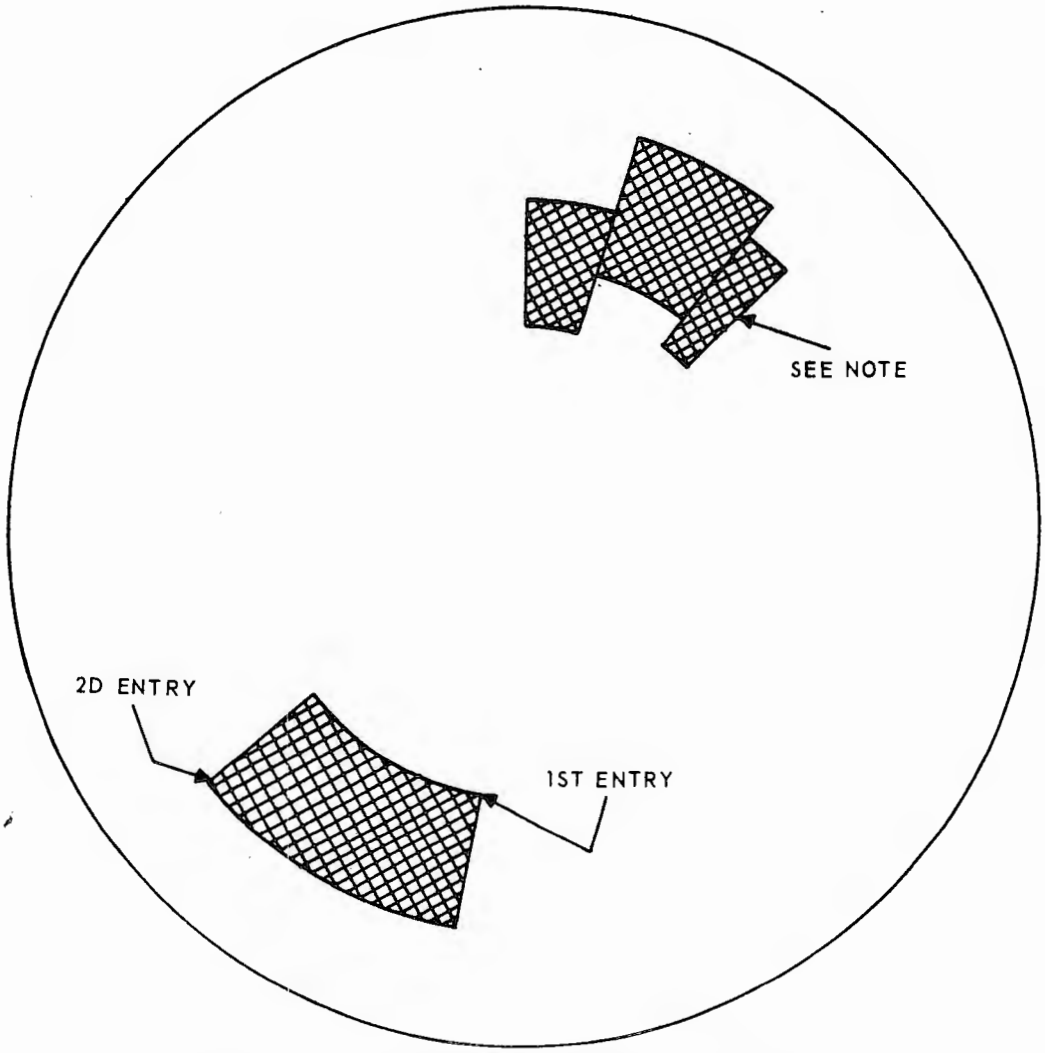
(1) Inhibited sectors are entered into the system through the use of controls on the console available to the operator. By calling up the video ball tab symbol and enabling the track ball, the operator moves the ball tab to the azimuth and inner range where the inhibited sector should start. Then, by pressing the ENTER SECTOR pushbutton on the action entry panel of the console, he causes the coordinates of this point to be entered into the computer memory. The final boundary of a sector is established by the operator again moving the video tab to the azimuth and outer range and pressing the ENTER SECTOR push-

button. This action inserts a second set of coordinates into the computer memory, thereby defining the range and azimuth limits of the sector.

(2) It is important for the tracking console operator to know where inhibited sectors have been established. This is accomplished by use of the SECTORS video intensity control. Each area that is being carried in the computer memory as an inhibited sector is displayed on the PPI with a faint background brightening by slightly intensifying the radar sweep as it passes through these areas (fig. 25).

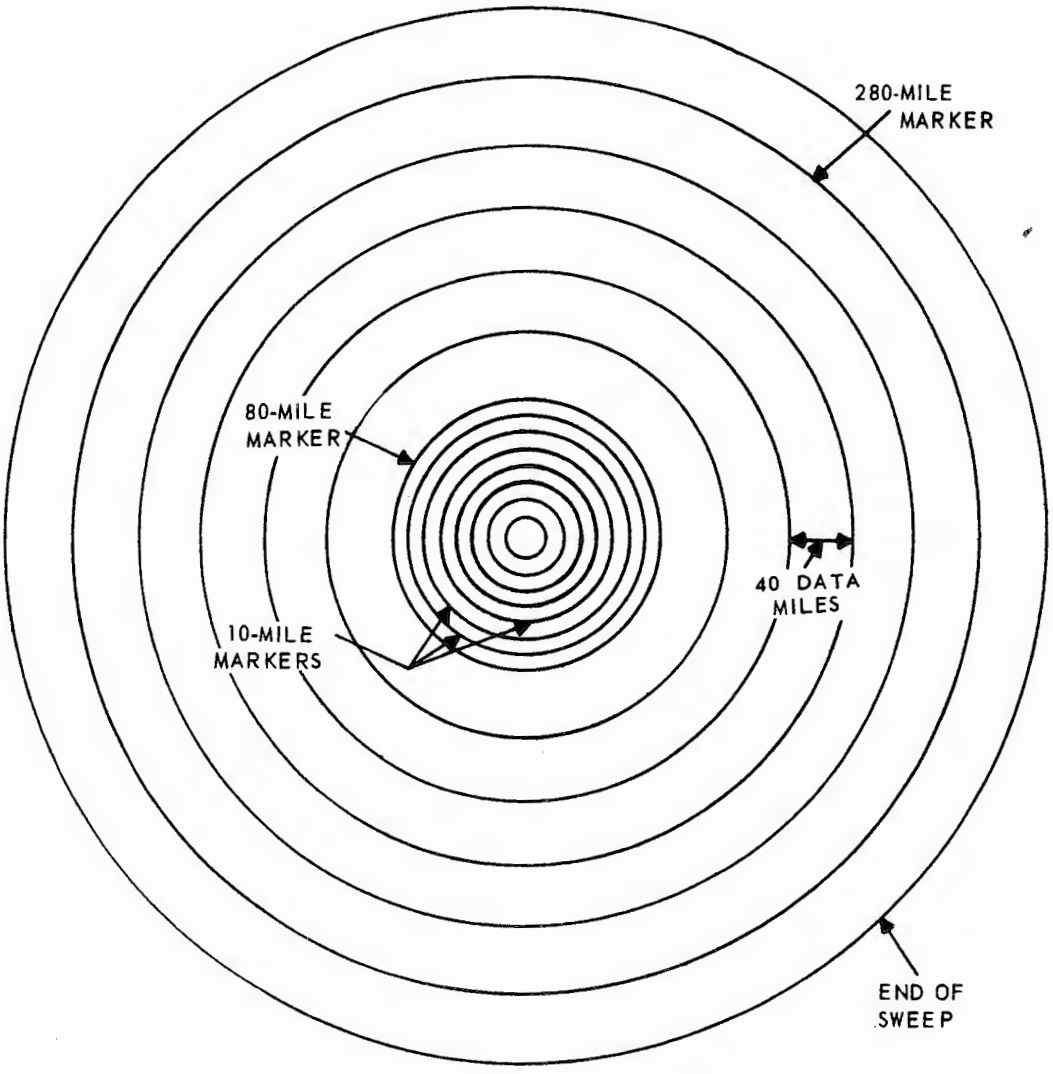
(3) IFF, target, and correlated video blips are also intensified when they appear within inhibited sectors so as to maintain the proper contrast between these blips and sector video.

d. To assist a console operator in approximating the range to a track or target, range marks which intensify the sweep at 13 distinct ranges, and appear as concentric circles about the sweep origin, are available to the operator by using the RANGE



NOTE. TOP INHIBITED AREA IS COMPOSED OF THREE SEPARATELY ENTERED AREAS.

Figure 25 (U). Examples of inhibited sector displays (U).



NOTES:

1. CONSOLE RANGE SWITCH SET TO 1/2 (320 DATA MILE RADIUS).
2. RANGE MARKS APPEAR AS CONCENTRIC RINGS ABOUT THE RADAR SWEEP ORIGIN, AND AT RANGES OF 10, 20, 30, 40, 50, 60, 70, 80, 120, 160, 200, 240, AND 280 DATA MILES FROM THE ORIGIN.

Figure 26 (C). Display console range marks presentation (U).

MARKS intensity to brighten the range marks display. Figure 26 shows 8 rings which appear at 10-mile intervals and 6 rings which appear at 40-mile intervals. The outermost ring is not the result of a range mark; it is the end of the radar sweep line and, consequently, no video can be displayed on the PPI beyond the limit of the outermost ring which is 320 miles from the sweep origin. The maximum distance that sweep and range marks will be displayed is controlled by the pulse repetition frequency (PRF) of the collocated radar. (If the collocated radar has a range of only 150 miles, the radar sweep and range marks displayed on the PPI will not exceed this distance.) In figure 26 the sweep origin is at the geometric center of the PPI.

e. It is possible for tracks initiated at a remote source to be at coordinates which would place them beyond the normal presentation range (with the sweep origin at the center of the PPI). To enable the console operator to examine areas beyond the normal presentation range, offset controls are provided which permit the operator to select eight different sweep origin locations in addition to the normal center position, thereby permitting extended observation. The positions of the offset locations with respect to the center are east (E), southeast (S–E), south (S), southwest (S–W), west (W), northwest (N–W), north (N), and northeast (N–E). Figure 27 shows the locations of the eight offset positions and the center position. When the sweep origin is offset from the normal center, the area presented on the PPI is also affected by the display radius selected by the operator: 80, 160, 320, or 640 data miles, respectively.

f. During certain situations a console operator may wish to report the GEOREF coordinates or geographical location of targets to other facilities in the defense. Conversely, other facilities in the defense may wish to make similar reports to the AADCP under discussion. Available to the operator through use of the MAPS switch on the console are two maps which may be selected for display separately or together. Both maps are generated by the computer and will be displayed only at the console or consoles making the request for display as determined by the switch position of the MAPS switch—MAP 1, MAP 2, or both.

(1) Figure 28 is a typical boundary map produced from a series of straight lines representing boundaries of counties, states, or countries; landmarks such as towns or cities; and geographical references, such as lakes or rivers. The fact that only straight-line segments are used does not materially affect the PPI display, therefore, for all practicable purposes, the map can be considered accurate.

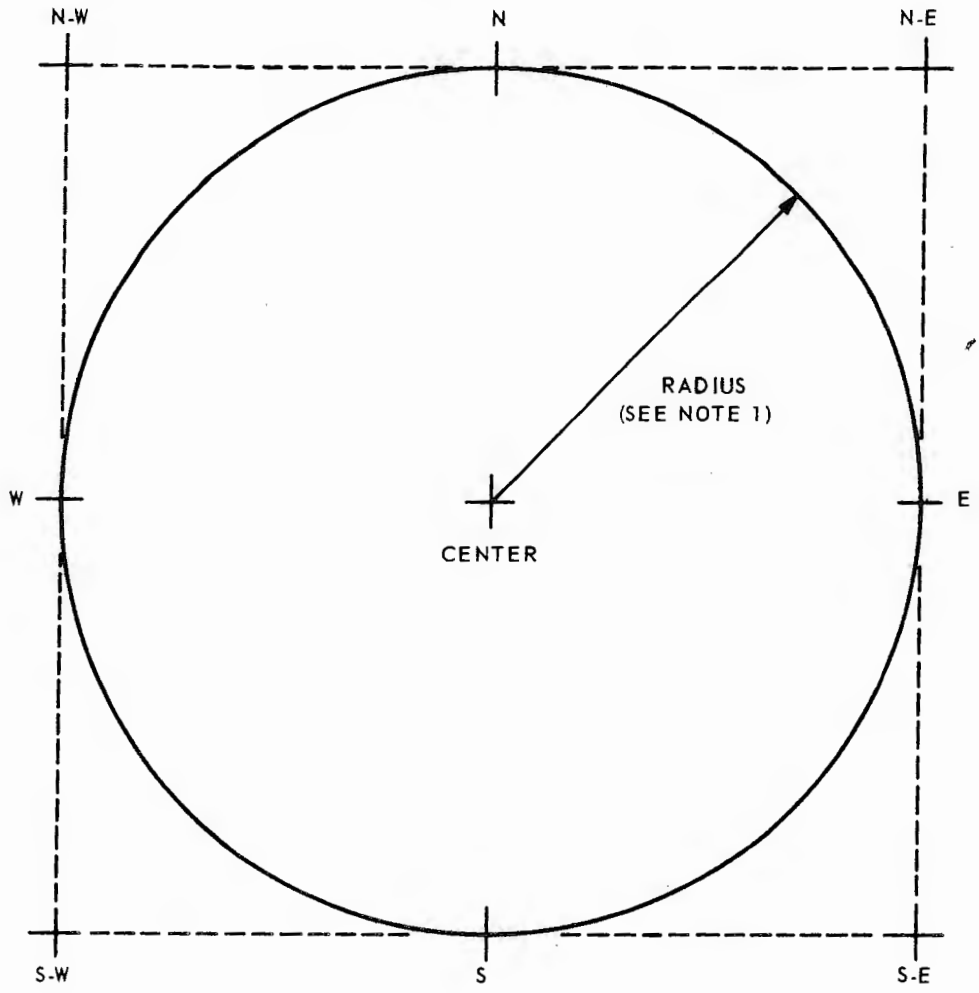
(2) The plus (+) marks shown in figure 29 are produced by the same method as all other symbols (friend, hostile, etc.). A major difference between this map and the boundary map is that each block of the map has 2 letters of the alphabet used to specify the block coordinates. The size of these letters remains constant regardless of the selected display radius range. The GEOREF map is selected with the MAP 1 position of the MAPS switch while the boundary map is selected with the MAP 2 position.

(3) To insure uniform brightness for all displays which are presented by the symbol beam of the PPI, intensity of the map displays and all other symbols and markers are controlled by the symbol intensity knob.

27. (C) Status Panels

a. Each AN/TSQ–51-equipped AADCP has status panel(s) capable of displaying the status of 24 fire units. One panel can handle the data only for 12 units; however, provisions are made for installation of a second panel should the defense contain sufficient fire units which would require use of both panels.

b. The information displayed is both manually entered for information that does not change frequently and automatically entered by a computer readout for information subject to rapid and frequent change. To obtain uniformity in the size of the alphanumerics used in the status panels, three sets of letters and three sets of numbers are provided for each fire unit row. The characters used in these sets are of the same size as those in the computer-driven module. (A status panel module is a small electronic package which contains 11 columns of letters and numbers which



NOTES:

1. THE LENGTH OF THE RADIUS (640, 320, 160, OR 80 DATA MILES) IS DETERMINED BY THE SETTING OF THE CONSOLE RANGE SWITCH.
2. EACH "+" DENOTES ONE OF THE NINE POSSIBLE LOCATIONS (EIGHT PLUS CENTER) OF THE DISPLAY ORIGIN.

Figure 27 (C). Display console offset positions (U).

are lighted by the computer readout. It is a plug-in device and is easily removed or replaced.)

c. Figure 30 shows across the top portion of the panel five columns allocated to categories of information to be displayed. From left to right, these categories are fire unit number (FIRE UNIT), state of alert (ALT STA), status (ST), primary command (PRIM), and secondary command (SECN). The information in the first two columns is inserted manually while the information in the remaining three columns is computer readout information.

d. An explanation of the five categories of information mentioned in *c* above is as follows.

(1) *Fire unit number.* In the fire unit number column (FIRE UNIT), a manual entry is used to display fire unit designation numbers, consisting of as many as two letters and two numbers per unit.

(2) *State of alert.* In the state-of-alert column (ALT STA), a manual entry is used to present the assigned state-of-alert or readiness, consisting of as many as three letters and/or numbers to indicate periods

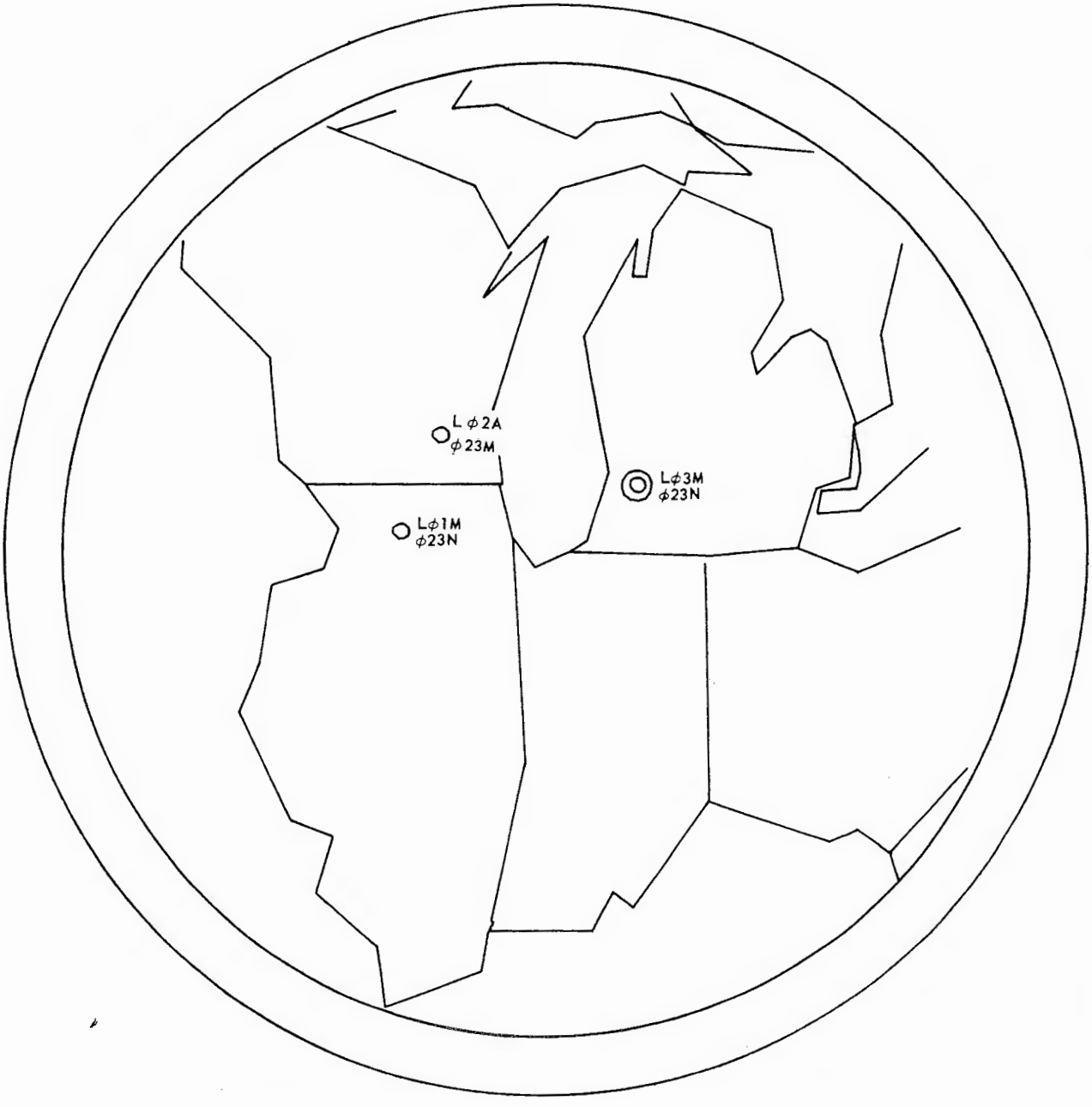


Figure 28 (U). PPI presentation of computer generated boundary map (U).

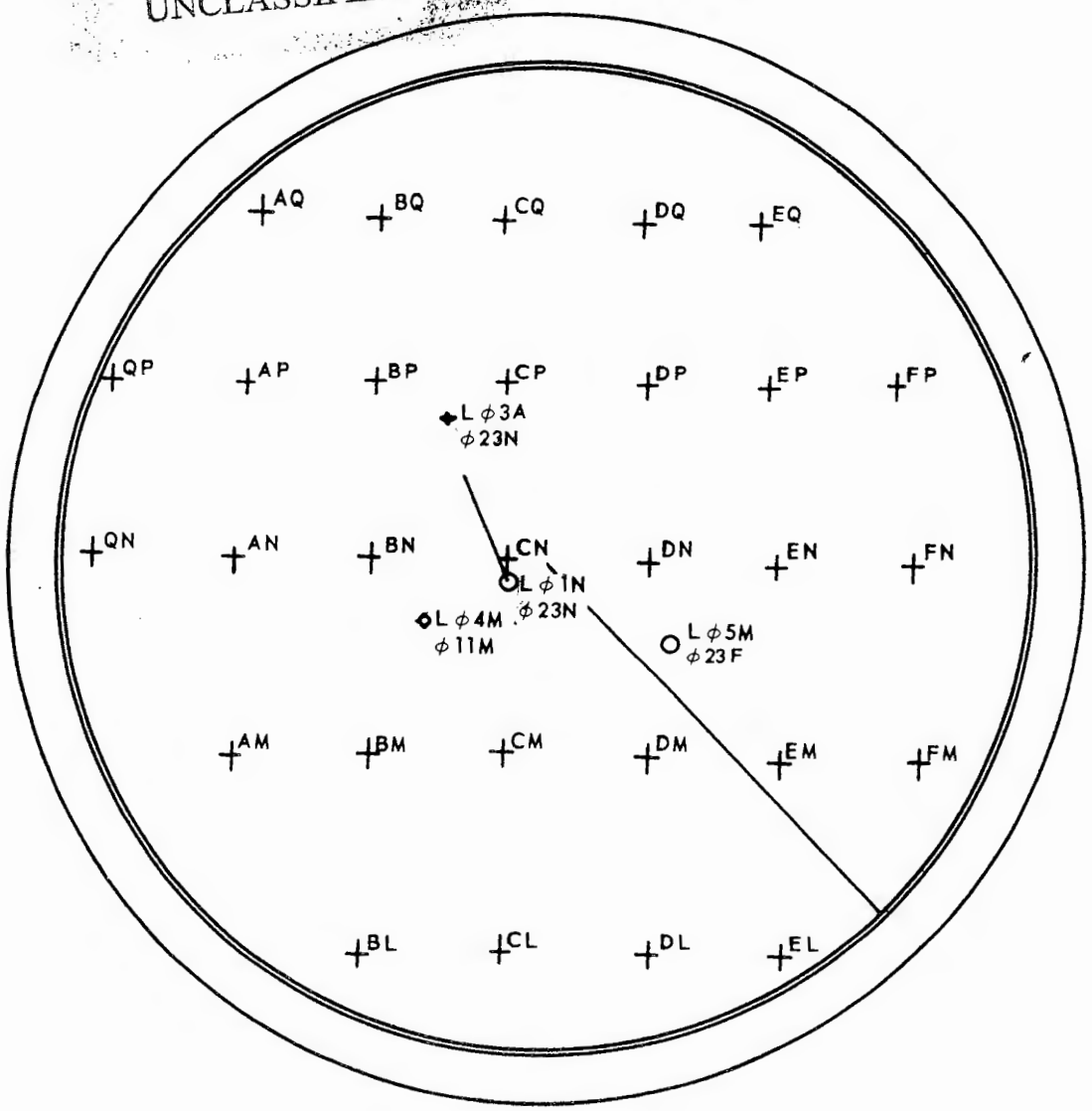


Figure 29 (U). PPI presentation of GEOREF intersections (U).

such as operational (OPR), 5 minutes, 15 minutes, 30 minutes, 3 hours, maintenance (MNT), or training (TNG).

(3) *Status.* In the status column (ST), a computer readout is used to display the actual status of the fire unit. These statuses can be ready (R), tracking (T), firing (F), effective (E), ineffective (I), kill (K), out-of-action (O), or status unknown (Ø). Status unknown (Ø) is displayed in CONUS defenses for out of action (O). This is due to the operation of CONUS battery data link equipment. Out of action (O) is not used in CONUS defenses.

(4) *Primary assignment.* Primary assignment is divided into two columns, target assignment number (ASGN) and command (C). Both columns are computer readouts which correspond to the designation sent to a fire unit. The target assignment portion contains four readouts which enable the display of the complete track number, such as SAGE/BUIC NM44 or local track L16M. The command column is used to display

COMPUTER READOUT

FIRE UNIT	ALT STA	S T	PRIM ASGN C	SEC N ASGN C
NY01	OPR	R		
NY02	OPR	R		
NY03	OPR	T L 1 6 M E		
NY04	OPR	R		

FIRE UNIT	ALT STA	S T	PRIM ASGN C	SEC N ASGN C
PH12	3HR	O		
PH13	OPR	F N M 4 4 E L O 3 A E		
PH14	MNT	ϕ		

CARD INSERTS

Figure 30 (C). Status panels (U).

the different commands sent to the fire unit: engage (E), hold fire (H), cease engage (C), no command has been given (Ø), or bookkeeping pair (B).

(5) *Secondary assignment.* Secondary assignment is arranged the same way as primary assignment; however, the secondary assignment is not sent to the fire unit until the primary assignment is terminated. Secondary assignment is used to record or register the next assignment to be sent to the fire unit when the presently assigned task is completed.

e. Operations in the AADCP normally will be conducted under dim lighting conditions with only blue ceiling lights furnishing illumination. So that console operators can properly read the fire unit number and state of alert columns of the status panel(s), the alphanumeric sets are made of luminescent material which glows in the dark. The remaining columns present no reading problem because their lighting is electronically controlled.

28. (U) Plotting Board and Display Rack Control Panel

a. Figure 31 shows the manual plotting board contained in the operations trailer. The board utilizes a transparent, acrylic marking plate that readily accepts markings from conventional china marking pencils. Illumination of the board is accomplished through edge lighting. Normally, the board will be marked from the viewing side, but can be marked from the rear with the rear panel removed. Provisions are made for the board to accept paper maps or equivalent background references for plotted data.

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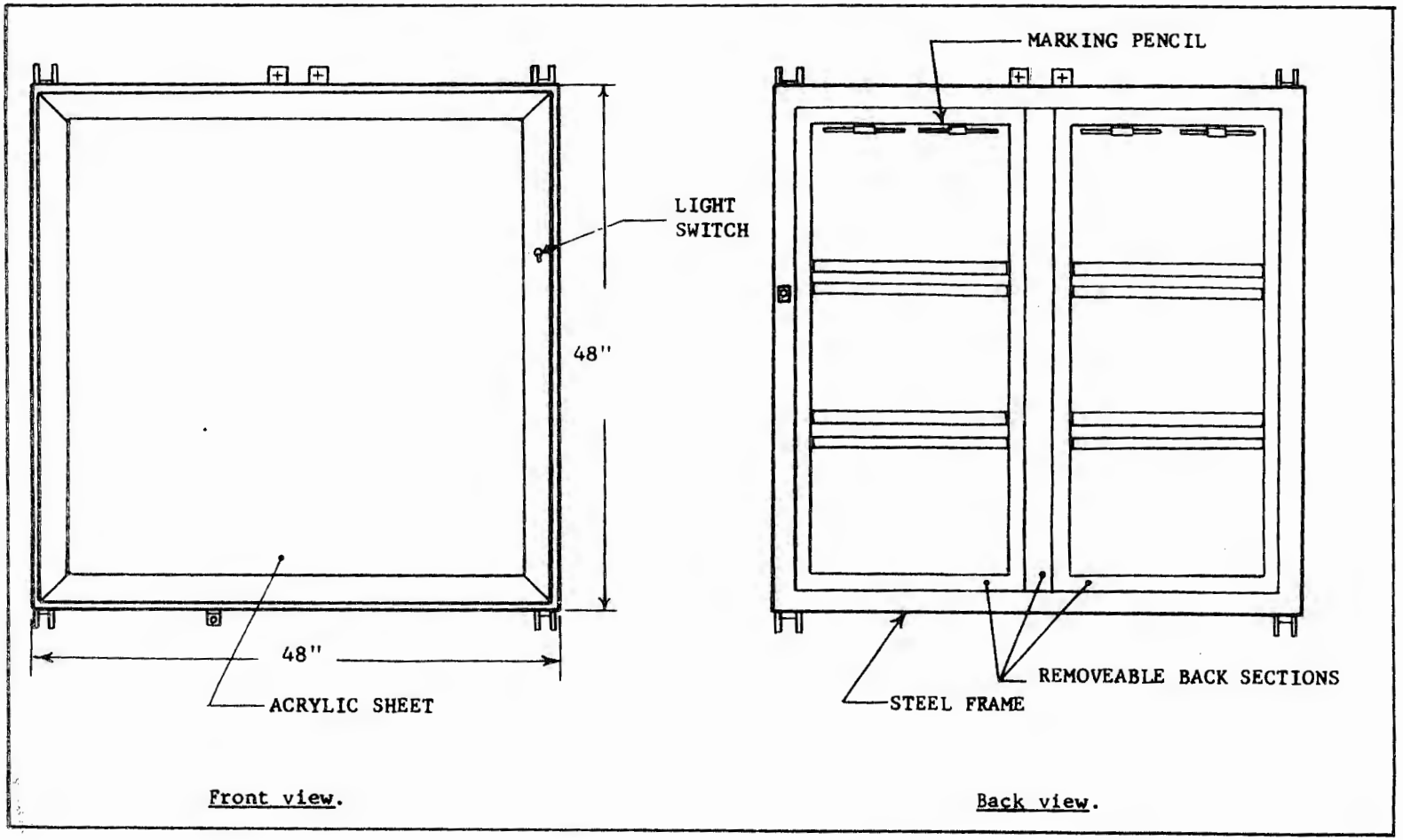

Figure 31 (U). Plotting board (U).

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b. The board is maintained in the stowed position during normal operations. To establish the board in the operating position requires that the status panels be pivoted back and locked before the board can be swung down and locked in position for use.

c. The display rack control panel is not considered a display element in the operations trailer but because some of its controls affect the display of tracks on the PPI's, it is explained in (1) through (3) below. Figure 32 shows four switches which control the transmission and display of tracks as follows—

(1) *CATEGORY REFERENCE.* These two switches allow the AADCP personnel to select reference tracks by category (FRIENDLY or HOSTILE—both or neither) for transmission to the fire units.

(2) *SAGE/BUIC SIM TRACKS.* When this switch is turned to DISPLAY, simulated tracks received from SAGE/BUIC can be displayed on the console PPI's. When turned to DISPLAY AND TRANSMIT, the simulated SAGE/BUIC tracks are also transmitted to the fire units as reference tracks. Simulated tracks and the switch controlling their display and transmission are used only during training exercises when no live targets are available.

(3) *TRACKING MODE.* This switch determines the type of video to be used for automatic tracking. When turned to RADAR, the video processor circuits will process primary acquisition video skin returns. When turned to BEACON, secondary acquisition (IFF/SIF) video replies will be processed. The switch also causes the IFF interrogator (in the radar) to be enabled when it is turned to BEACON. The IFF responses are displayed on all consoles.

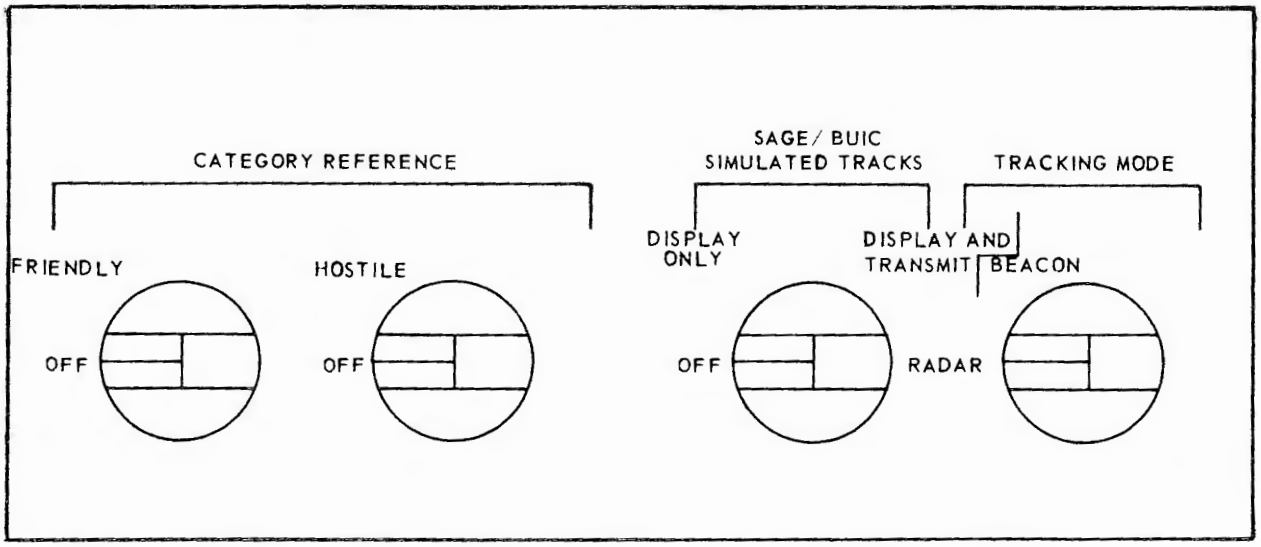

Figure 32 (U). Display rack control panel (U).

CHAPTER 6 (C)
OPERATIONS (U)

29. (U) General

a. During an engagement operational functions will be performed by the tracking and tactical console operators. These functions include entry of tracks, updating of manual tracks, hooking tracks by any of three procedures, handling of blinking symbols, entering or changing height, pairing a console to a fire unit, making track assignments to fire units, and referencing tracks for transmission to the fire units.

b. Not all of the console controls and indicators are used in the tracking or tactical mode. Use of the controls and indicators for both modes is explained in paragraphs 19 through 23.

c. Except for the intensity, focus, astigmatism, and centering controls, all general purpose console pushbuttons, dials, and rotary switches, when operated, will be effective only if the system computer has the operational program entered into its memory. The operational program is a set of instructions stored in the computer memory and is the means by which the general purpose computer is used in a special purpose application; in this case, to solve the air defense problem for a particular defense.

30. (C) Preparation of Equipment for Use

a. Before the equipment is used operationally, the operational program and certain data peculiar to the defense area in which the system is being employed must be entered into the computer memory. These data consist primarily of—

(1) GEOREF coordinates for—
  (*a*) The collocated radar.
  (*b*) Organic RRIS's.
  (*c*) Adjacent AADCP's.
  (*d*) Subordinate missile fire units.
(2) Altitude of the collocated radar (in feet).
(3) GEOREF coordinates and radius (in data miles) of certain areas within the defense where radar tracking is poor and of other selected areas for which target threat evaluations are to be computed.

b. These data are necessary during system operation in that they provide references against which target position and fire unit position information is correlated. Space is provided in the computer memory for these data and during operation the computer continually uses this stored information in its computations.

c. Once these data have been entered into the computer memory, a tape containing all of the site constant information is punched, thereby preserving the information. The reason for preserving this data on a punched tape is that whenever diagnostic routines are being used in the computer, the data stored in the memory locations assigned for site constant data are destroyed and replaced by diagnostic data. Having the data on a punched tape facilitates quick reentry of the data upon completion of diagnostic routines.

d. Maintenance personnel insert data into the memory unit from punched tape or typewriter prior to system operation. Operating personnel must keep in mind that proper preparation of the computer is essential to successful overall operation of the AN/TSQ–51 fire distribution system.

e. Other data, such as that required for display of map and sector video, are also preserved on tape and, like site constant data, must be reentered into the computer memory upon completion of any diagnostic routine.

f. Diagnostic routines are special programs read into the computer which assist maintenance personnel in locating malfunctions and determining adequacy of overall system performance.

g. The computer at an RRIS must be prepared in a manner similar to that at the AADCP; however, the volume of site constant data required

for the RRIS computer is not as large. Here, too, operational data is preserved on tape to facilitate quick reentry after completion of diagnostic routines.

31. (U) Description of Number Entry Dials

a. The number entry dial assembly (fig. 7) is made up of five thumb-operated switches that control the entry of letters, numbers, or both, but must be used in conjunction with other controls to affect an entry into the system.

Note. When reference is made herein to these switches, the leftmost switch will be called the first switch and the rightmost switch will be called the fifth switch (fig. 7).

b. The first switch controls the entry of 10 letters, A, B, C, D, E, L, R, S, Y, and Z. For L/R TN hooking, the letters A, B, C, D, and E are used to select the *remote* source designator and the letters L and S are used for *local* actual and simulated tracks, respectively. The letters A, B, and C are also used in conjunction with the SPECIAL pushbutton to denote the type of special track as determined by SOP.

c. The second switch controls the entry of 15 letters, A, E, G, H, J, K, L, M, N, P, T, U, V, X, and Y. This switch is used during S/B TN hook procedure to select the first or leftmost character of an S/B track number.

d. The third switch controls the entry of seven numbers, 0 to 6, or eight letters, G, H, J, K, L, M, N, and P. The letters or numbers are used to select the second character of an S/B track number when hooking a track by the S/B TN hooking procedure. The numbers are also used to select the first or leftmost number for a manual height entry.

e. The fourth and fifth switches contain only numbers, 0 to 9, and are used for several different purposes. When entering height manually, the fourth switch is used to select the second number of the height set and fifth switch is used to enter the third or rightmost number of the height set. When hooking a track either by L/R TN hook or S/B TN hook, these switches are used to select the track numbers. Additionally, the fourth and fifth switches are used to select a function code number which, when entered into the system, causes a computer-controlled action to be initiated, such as a LOCAL simulated video dot to appear on the PPI.

32. (U) Use of Number Entry Dials

The following examples portray the use of the number entry dials, along with other controls, whenever a console operator desires to hook a track by number, change the type for a special track, manually enter height for a local track, or enter a local simulated track.

a. Hooking a Track by TN Hook Procedure.

(1) Regardless of the source of the track (local, remote, or SAGE/BUIC), the producer for TN hooking any track is the same, except for the letter dial(s) used for tracks from different sources. The operator is reminded that the display of tracks is controlled by the CATEGORY SELECTION switches (S/B, REMOTE, LOC-MAN, LOC-AUTO, FRIEND, UNKNOWN, and HOSTILE), and alphanumerics for tracks cannot appear with the track marker unless the TRK DATA pushbutton has been pressed. The one exception is that the alphanumerics for a *hooked track* always appear with the track marker regardless of the method used to hook a track (POS HOOK, SEQ HOOK, or TN HOOK). The information contained in the alphanumerics displayed is required to assist the operator in implementing the TN hook procedure.

(2) In addition to the display of tracks being controlled by category selection, other conditions for remote tracks must be satisfied.

(*a*) Only tracks from an adjacent AADCP that have been engaged or have been flagged as special will be accepted for display at the receiving AADCP.

(*b*) Only those tracks from an associated RRIS not already existing as an AADCP local track, or an RRIS track flagged as special will be accepted for display by the parent AADCP.

(3) Keeping the requirements in (1) and (2) above in mind, the operator can then proceed to TN hook a track as follows:

(*a*) *Local tracks.*

1. Set the first switch on the number entry dial to the letter L.

2. Set the fourth and fifth switches to the number of the track.
3. Press the L/R TN HOOK pushbutton.
4. The hooked track marker appears around the track symbol.

(*b*) *Remote tracks.*

1. Set the *first* switch on the number entry dial to the source code designator (A, B, C, D, or E).
2. Set the *fourth* and *fifth* switches to the number of the track.
3. Press the L/R TN HOOK pushbutton.
4. The hooked track marker appears around the track symbol.

(*c*) *SAGE/BUIC tracks.*

1. Set the *second* and *third* switches to the letters (the third switch would be used to set in a number if the track number was, for example, one letter and three numbers) of the track.
2. Set the *fourth* and *fifth* switches to the appropriate numbers.
3. Press the S/B TN HOOK pushbutton.
4. The hooked track marker appears around the track symbol.

b. Flagging a Track as Special.

(1) Only tracks which originate at an AADCP or its associated RRIS will be considered for special flagging. The track must first be hooked to the console by either of the three methods of hooking (POS HOOK, SEQ HOOK, or TN HOOK).

(2) When the track is hooked, the operator proceeds as follows:

(*a*) Set the first switch to the letter A, B, or C.

(*b*) Press the SPECIAL TRACK pushbutton.

(*c*) The identity marker for the track is changed to a special marker. The original identity of the track is unchanged as far as the computer memory is concerned and only AADCP's and RRIS's will see any significant change in the track appearance on the PPI, that being the change of marker and the appropriate letter (A, B, or C) appearing in the alphanumeric field.

c. Manually Entering Height.

(1) All local tracks are initially assigned an arbitrary height (also called pseudo-height) of 23,000 feet. This arbitrary height is assigned because the AN/TSQ-51 system will not always be tied in to height-finder radars. However, changes to this arbitrary height can be made by the console operator with a manual height entry if, through local height-finder radar or other facilities (Air Force or Adjacent AADCP's), height determination can be made.

(2) Keeping in mind that the console must have the track under close control (hooked), the console operator can then proceed to manually enter height for the hooked track as follows:

(*a*) Set the third, fourth, and fifth switches on the number entry dial to the value of the height (in thousands of feet) to be entered for the track.

(*b*) Press the ENTER HEIGHT pushbutton.

(*c*) The height is now entered in the computer memory location for that track and the alphanumerics on the PPI will indicate the new height.

(3) Only the numbers set into the three rightmost dials (third, fourth, and fifth) will enter the system when the ENTER HEIGHT pushbutton is pressed. The setting of the two leftmost dials (first and second) is immaterial during manual height entry because control circuits allow data to be entered only from the three rightmost dials when entering height.

d. Entering a Local Simulated Track.

(1) The local simulated video dot can only be enabled and displayed on a console that has been placed in the tracking mode of operation. It is a useful device for training tracking console operators to track targets, using the rate-aided procedure.

(2) To activate the simulated video dot, the operator proceeds as follows:

(*a*) Set the two rightmost number entry switches (fourth and fifth) to 20.

(*b*) Press the FUNCTION CODE pushbutton.

(*c*) The local simulated video dot now appears in the center of the PPI.

(3) The dot will move outward from the center of the PPI at a slow rate and then move in a clockwise circular path concentric with the center (fig. 33).

(4) The operator can enter a single local simulated track which can be tracked by the rate-aided procedure. This track cannot be given identity or made a special track, but it can be manually updated, given a raid size and a height, hooked by any means, and dropped.

(5) Dropping this track does not remove the local simulated video dot. This must be removed from the system display as follows:

(*a*) Set the two rightmost switches (fourth and fifth) to 21.

(*b*) Press the FUNCTION CODE pushbutton.

(*c*) The dot now disappears from the PPI and the coordinate data stored in the computer track store memory is destroyed.

Caution: **Improper use of the number entry dials by operating personnel for any purpose other than that for which intended could cause an erroneous entry by alteration of track data for established tracks through misuse of the number entry dials and FUNCTION CODE pushbutton.**

33. (U) Establishing a New Track

a. New tracks can be entered into the system only with the controls on a console in the *tracking mode* of operation. The action entry controls mentioned in *b* through *f* below are shown in figure 8.

b. To enter a new track into the system—

(1) Press the VIDEO TAB pushbutton on the action entry panel.

(2) Press the track ball enable pushbutton on the operator's shelf.

(3) Rotate the track ball in a direction that will place the video tab over the target video..

(4) Press the NEW TRACK pushbutton on the action entry panel.

c. The coordinates for the new track are entered into the computer memory and the hook symbol appears over or near the target video. The unknown track symbol, video ball tab, and the alphanumerics for a newly entered track appear simultaneously with the hook symbol.

d. New track alphanumerics always indicate the *manual* mode of tracking, a *raid size* of no estimate, and an arbitrary *height* of 23,000 feet. While the operator has the track hooked he can proceed to make changes in height, raid size, and tracking mode and, if identity of the track can be established, he can change the track marker accordingly. Assignment of a track number is done automatically by the computer, consequently no action is required by the operator to assign track numbers to tracks.

e. To *update* a manual track, the operator must first have the track hooked by any of three methods. Any hooking procedure will cause the hook symbol and the video tab to appear at the coordinates of the hooked track so it is not necessary to activate the video tab. With the track hooked, update the track as follows:

(1) Press the track ball enable pushbutton on the operator's shelf.

(2) Using the track ball, place the video tab over the position of the target video.

(3) Press the TRACK UPDATE pushbutton on the action entry panel.

f. New coordinates for the track are now entered into the computer memory. After updating, a velocity will be established which will cause the track to move with the video (provided the velocity remains constant), thereby, resulting in continual updating of the track coordinates. If the track is made an *auto* track, updating is performed automatically by the computer.

34. (U) Hooking Tracks

a. Tracks can be hooked on a tracking console by any of three available methods, POS HOOK (position hook), SEQ HOOK (sequence hook), and TN HOOK (track number hook, either L/R (local/remote) or S/B (SAGE/BUIC)).

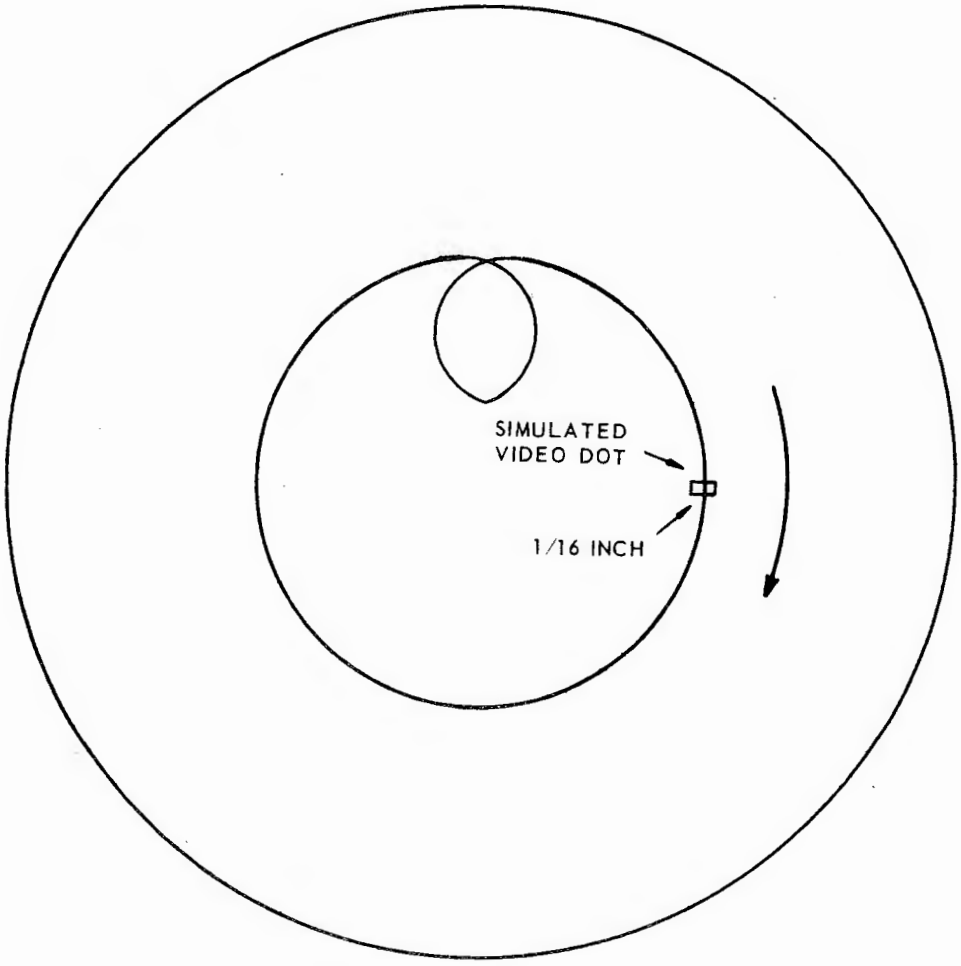

Figure 33 (U). Path of simulavted ideo dot (U).

b. POS HOOK can be applied to any track displayed on the PPI regardless of the source of the track. This hooking procedure is done as follows:

(1) Press the SYMBOL TAB pushbutton on the action entry panel.
(2) Press the track ball enable pushbutton on the operator's shelf.
(3) Rotate the track ball in a direction that places the symbol tab over the track marker of the track to be hooked.
(4) Press the POS HOOK pushbutton on the action entry panel.

c. The hook symbol will now appear over the track marker and the symbol tab is replaced by the video tab (if the track is a local or locally enabled SAGE/BUIC track). Both tabs (symbol or video) cannot be presented on the PPI at the same time and during any hook process on a tracking mode console the video tab always replaces the symbol tab. This results in the video tab being readily available at the track location if track updating is required.

d. Sequence hooking is the quickest hooking procedure that can be used by the tracking console operator; however, only those tracks comprising *tracking mode sequence set* can be hooked in this manner. *Tracking mode sequence set* is made up of all blinking tracks and tracks being tracked in the RAMIT mode.

e. Sequence hooking is accomplished by pressing the SEQ HOOK pushbutton on the action entry panel. The next track in numerical sequence is hooked if it is a blinking or manual track. As with position hooking, the video tab and the hook symbol appear over the track marker.

f. The remaining method of hooking tracks, local/remote track number hooking or SAGE/BUIC track number hooking, requires use of the number entry dials and certain pushbuttons on the display control panel. Track number hooking procedures are explained in paragraph 32*a*. As with the position hooking procedure, any track in the system can be hooked by this process.

35. (U) Blinking Symbols

a. Conditions relative to a track or tracks may arise which require the immediate attention of the tracking console operator. To alert the operator, that such a condition exists, a track marker will blink. Blinking alerts the operator that a priority situation exists and he must hook the track to determine the cause of the blinking. As explained in paragraph 34*e*, sequence hooking is the quickest means of hooking a blinking track marker.

b. After hooking the blinking track marker, one of the alert indicator lamps on the action entry panel will be lit, indicating the reason for the track blinking. The operator can then take the necessary action for the priority.

c. Normally a tracking console operator concerns himself only with priority situations which cause the POOR AUTO, POOR MANUAL, or HEIGHT RETURN alert indicator lamps to light. Listed in (1) through (3) below are reasons and remedial action for the three indicator lamps when lit.

(1) The POOR AUTO indicator lamp, when lit, indicates that the tracking quality in automatic tracking has degraded. This will occur if the track has not been correlated for approximately five radar scans. The blinking track will stop blinking when automatic tracking conditions improve or after being changed to a manual track and updated.
(2) The POOR MANUAL indicator lamp, when lit, indicates that the period of successive updates for the track has exceeded 5 minutes. The blinking will stop with a manual update or after changing it to an *auto* track with an automatic update.
(3) The HEIGHT RETURN indicator lamp, when lit, indicates that a height return has been received from a height-finder radar in response to a manual request. The blinking will stop with a manual height entry.

d. Although not considered as part of the blinking symbol set, the AUTO TRK OVERFLOW lamp on the display control panel, when lit, will require operator action. When lit, it indicates that the maximum number of automatic tracks that the computer can handle has been exceeded and no more automatic tracks are possible. To relieve the situation, one course of action open to the operator is to remove low priority tracks from the system; i.e., friendly tracks or those tracks at range where they offer no immediate threat to the defense. Unit SOP will

normally control actions to be taken in such a situation.

36. (C) Assigning Tracks to Fire Units (Centralized Control)

a. Assignment of tracks to a fire unit can only be accomplished from a general purpose console that has been placed in the tactical mode of console operation; however, placing a console in the tactical mode does not automatically permit assignment of tracks to fire units. The console must first be paired to a fire unit before assignment can be effected. Any given console operating in the tactical mode can have coupled (paired) to it a maximum of 24 fire units; however, any given fire unit can be coupled to only one console at a time. Coupling a fire unit to a different console automatically breaks any link that the fire unit had with any other console. Unit SOP normally will determine which fire units will be paired to specific consoles.

b. Procedure for coupling a fire unit to a console follows:

(1) Press the FU pushbutton on the category selection panel. This causes the fire unit positions and associated alphanumeric to be displayed on the PPI.

(2) Press the SYMBOL TAB pushbutton on the action entry panel.

(3) Press the track ball enable pushbutton on the operator's shelf.

(4) Using the track ball, position the symbol tab over a fire unit site marker and press the FU HOOK pushbutton. The hook symbol now encircles the fire unit site marker.

(5) Press the FU TO CONSOLE pushbutton on the action entry panel. The fire unit is now coupled to the console and the console number to which the fire unit has been coupled appears in the alphanumeric field for that fire unit position.

c. Having once coupled a fire unit to a console, changing the mode of console operation in no way affects pairings. Thus, a console can be switched to any of the other modes; however, the console must be returned to the tactical mode in order to make track assignments or send commands.

d. Decoupling a fire unit from a console can be accomplished by another console going through the coupling procedure or by repeating the coupling procedure at a console already coupled. When the procedure is repeated, pressing the FU TO CONSOLE pushbutton causes the fire unit to be decoupled from the console in question.

e. The procedure to designate a track to a fire unit follows:

(1) Gain close control of a friendly or hostile track by any of the three hooking procedures.

(2) Press the track ball enable pushbutton. and position the symbol tab over the fire unit site marker.

(3) Press the ENGAGE TRACK pushbutton An ENGAGE command is transmitted to the fire unit and a primary designation flag (X) appears at the track coordinates joined to a blinking fire unit site marker by a blinking pairing line. The pairing line continues to blink until the fire unit acknowledges receipt of the command, but the fire unit *site* marker will continue to blink.

(4) When the fire unit status changes to *tracking,* the letter T appears in the alphanumeric display of the fire unit site location and the fire unit *site* marker will stop blinking. The primary designation flag (X) is replaced by the fire unit tracking marker (also an X) and indicates the position of the target with respect to the fire unit's tracking radar.

f. It is possible to designate a particular track to more than one fire unit; however, any single fire unit can only engage one track at a time. A secondary assignment can be made to any given fire unit, but it is not transmitted to the fire unit until a terminal status (effective, ineffective, or kill) has been affected on the primarily assigned track. When this occurs, the system computer causes the secondary assignment to become a new primary assignment and it is automatically transmitted to the fire unit. As before, the primary designation flag and a blinking pairing line appear on the PPI and the fire unit proceeds to engage the new track.

37. (U) Terminating a Track Assignment

a. Any engagement by a fire unit can be terminated by use of HOLD FIRE or CEASE EN-

GAGE commands. At the fire unit (Nike Hercules or Hawk) the received HOLD FIRE command causes a buzzer to sound, a HOLD FIRE lamp to light, and all symbology (except for that track for which the command has been designated) to disappear from the fire unit's PPI. When the command, CEASE ENGAGE, is designated, the fire unit receives this command as a CEASE FIRE and again a buzzer sounds, a CEASE FIRE lamp lights, and all symbology (except for that track for which the command has been designated) disappears from the fire unit's PPI.

b. While the AN/TSQ–51 fire distribution system has only two means of designating the termination of an engagement (HOLD FIRE and CEASE ENGAGE), ARADCOM SOP requires that three commands, HOLD FIRE, CEASE ENGAGE, and CEASE FIRE, be used for engagement termination. These three commands are—

(1) *HOLD FIRE.* Intended primarily for the protection of friendly aircraft and means—

(*a*) If the unit has fired a missile, immediately *destroy* the missile and cease tracking.

(*b*) If the unit has not fired a missile, do *not* fire and cease tracking.

(2) *CEASE ENGAGE.* Used to alert a unit already engaging a target to a target of higher priority and means—

(*a*) If the unit has fired a missile, permit the missile to engage the target and then transfer to a new target.

(*b*) If the unit has not fired a missile, do *not* fire, cease tracking, and lock on the new target.

(3) *CEASE FIRE.* Used to preclude simultaneous engagement by both interceptor aircraft and surface-to-air missiles and means—

(*a*) If the unit has fired a missile, permit the missile to continue to intercept.

(*b*) If the unit has not fired a missile, do *not* fire and continue tracking the target.

c. When the command CEASE ENGAGE is transmitted, it must be accompanied by voice communication to the fire unit to clarify whether CEASE ENGAGE or CEASE FIRE is to be implemented.

d. The command, HOLD FIRE, needs no clarification.

e. Procedure to terminate an engagement, using the CEASE ENGAGE (CEASE FIRE) command, is as follows:

(1) Gain close control of the track by any of the three track hooking procedures.

(2) Press the track ball enable pushbutton and position the symbol tab over the fire unit site marker.

(3) Press the CEASE ENGAGE pushbutton. A CEASE ENGAGE command is transmitted to the fire unit, the pairing line starts blinking, and the letter C appears in the alphanumerics for the fire unit site display and in the command column on the status panel. When the fire unit acknowledges receipt of the command, the pairing line disappears from the PPI's at the AADCP. If the voice communication to the fire unit indicated that the command was a CEASE ENGAGE rather than a CEASE FIRE, and a secondary assignment had been made to the unit prior to termination of the aforementioned track, then a new ENGAGE command would be transmitted automatically to the fire unit. The fire unit would acknowledge, permit the missile to continue to intercept, and then proceed to engage the new target. If the command was in fact a CEASE FIRE, then the unit would permit the missile to continue to intercept, acknowledge receipt of the CEASE FIRE command, and continue to track the target.

f. A HOLD FIRE command can be implemented on any track active in the system (local S/B, remote, or fire unit initiated) to any fire unit subordinate to the AADCP engaging the track. For an S/B track, the command is initiated by SAGE/BUIC and is automatically transmitted by ADL through the AADCP equipment directly to any units engaging the track. This is the only command sent by SAGE/BUIC directly to fire units. To designate a HOLD FIRE command to all fire units engaging a local or remote track, proceed as follows:

(1) Gain close control (hook) of the track.

(2) Press the HOLD FIRE pushbutton. All

fire units paired to the track will receive the HOLD FIRE command, the pairing line(s) on the PPI's at the AADCP will blink, and the letter H will appear in the alphanumerics for the fire unit site and in the command column(s) on the status panel. When the fire unit receives this command any in-flight missile should be destroyed immediately and the unit should cease tracking and acknowledge receipt of the command. When the acknowledge is received at the AADCP and the fire unit has ceased to track the target, the pairing line and the fire unit tracking marker (X) disappear from the PPI's at the AADCP.

g. Procedure to designate a HOLD FIRE command to a fire unit engaging its own track (fire unit initiated track) is as follows:

(1) Press the SYMBOL TAB pushbutton.

(2) Press the track ball enable pushbutton and, using the track ball, position the symbol tab over the fire unit tracking marker.

(3) Press the FU HOOK pushbutton.

(4) Press the HOLD FIRE pushbutton. The fire unit proceeds to destroy any in-flight missiles, ceases tracking, and acknowledges receipt of the HOLD FIRE command.

38. (U) Operational Profiles

a. Tables 6 through 9 are to assist operating personnel in understanding the sequential actions which occur when a particular function is implemented by a console operator. It is not intended that the steps indicated in the profiles be necessarily followed in the numerical order shown. This numerical order progressively covers all controls used by operators for tactical operations.

b. Table 6 shows the step-by-step procedure for placing a general purpose console in the tracking mode of operation and continues with an explanation of the functions used by a tracking console operator in performance of his duties.

Table 6 (C). Tracking Mode Functions (U)

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
1	Establish tracking display.						
	Assume tracking mode.	Turn console mode selector switch to TRKG.		Console sends change mode function code to computer.			
			All action entry labels go out.				
		Press ENTER MODE pushbutton.		Mode function code is sent to computer.			
			Action entry button labels for tracking mode light.				
2	Use of video ball tab to point out selected video returns.	Press VIDEO TAB pushbutton on action panel.	Video tab appears at display origin.				

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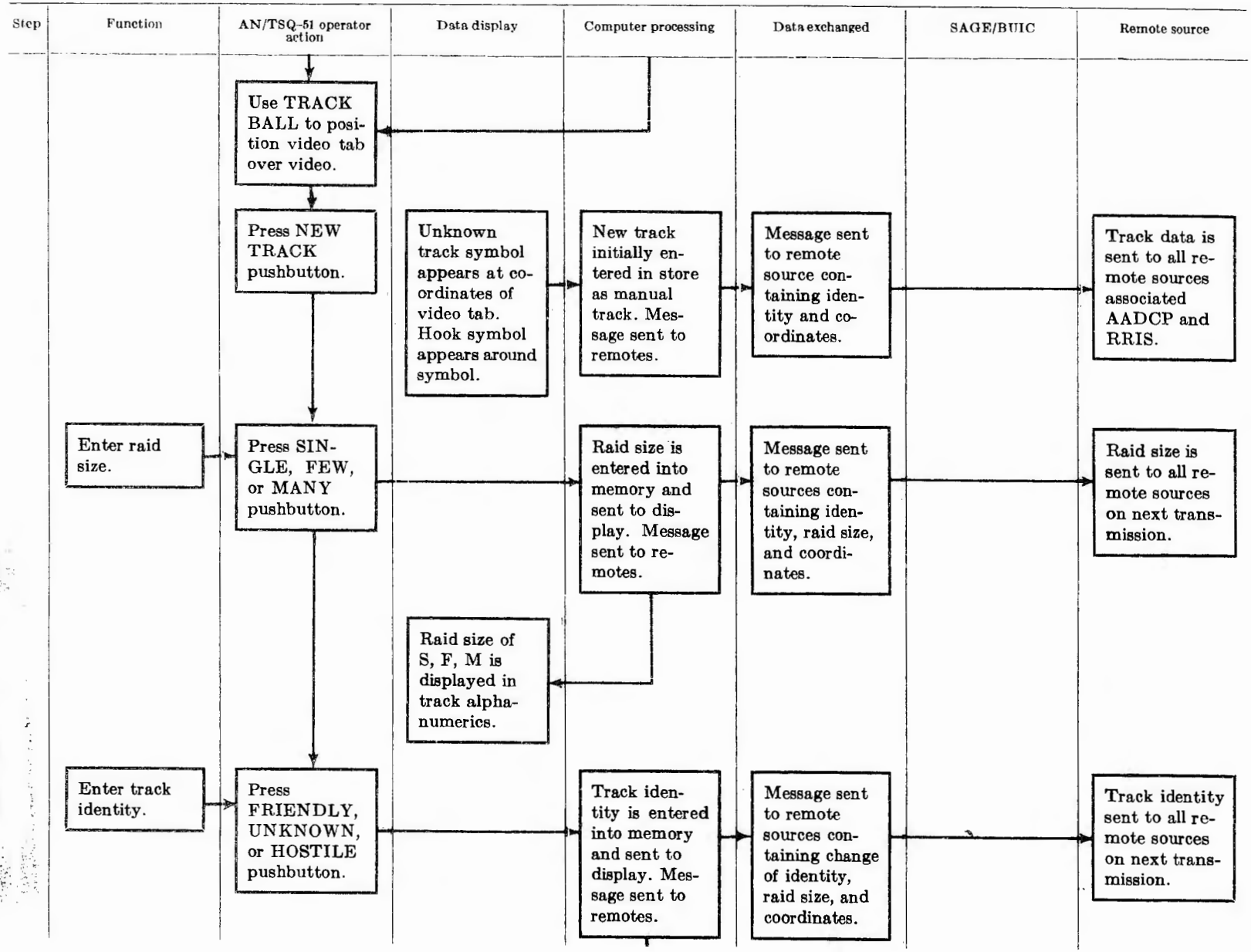
Press ENABLE pushbutton. Move video ball tab over selected video.
Coordinates are entered and video tab is moved to selected video.
Video ball tab appears over selected video.
3
Use of symbol tab to point out selected symbol.
Press SYMBOL TAB pushbutton on action panel.
Symbol tab appears at display origin.
Press ENABLE pushbutton. Move symbol tab to the selected symbol.
Coordinates are entered and symbol tab is moved to selected symbol.
Symbol tab appears over selected symbol.
4
Enter new local track.
Press VIDEO TAB pushbutton.
Video tab appears at display center.
Press ENABLE pushbutton.
Video tab can now be moved under control of track ball.

Table 6 (C). Tracking Mode Functions (U) — Continued



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5

Methods for gaining close control of track.

SEQUENCE HOOKING.

Press SEQ HOOK pushbutton.

Computer searches sequence set (LOC-MAN and all blinking trks). Coordinates sent to position hook and video tab.

Hook symbol and video tab appear at coordinates of next track in sequence.

Track identity is displayed as symbol change.

Note. When a track is hooked, the alphanumerics associated with that track are displayed independent of the setting of the TRK DATA category select pushbutton.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
	Track number hooking.	Set track number into NUMBER ENTRY dials.		Track number function code received by computer.			
		Press L/R TN hook or S/B TN hook push-button.	Hook symbol and video tab appear at co-ordinates of track whose number is selected.				
	Position hooking.	Press SYM-BOL TAB pushbutton.	Symbol tab appears at dis-play origin.				
		Press EN-ABLE push-button.					
		Move symbol tab over track symbol.					

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Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
		Press TRACK UPDATE pushbutton.		Velocity update automatically computed based on new position and time differential.			
			Track symbol and hook symbol are repositioned to video tab coordinates. Circle jump continues to update symbol to video.	Integration of velocity continues.			
	Update position of existing track.	Go through procedure for velocity entry above.					
7	Initiate track mode. Change auto to manual or manual to auto	Gain close control of a local track. Track mode indicated by A or M in alphanumerics.	Hook symbol and video tab appear at track coordinates.				

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8

Observation and entry of SAGE/BUIC tracks.

SAGE/BUIC in NORAD modes I, II and III transmit digital messages on track entered in the DC or NCC (for reference).

Messages contain size, identity, positional and velocity coordinates and track number sent to AADCP.

Decodes incoming data formats. Stores up to 64 SAGE/BUIC tracks. Integrates velocity. Sends coordinates, identity, track number, height, raid size to display.

Displays symbol of appropriate size and identity on all scopes which have been selected to display S/B tracks.

Observation and correlation with target video.

Press AUTO/MANUAL pushbutton.

Track investigated to determine mode of tracking. If manual, track is flagged for auto. If auto it is returned to manual.

Lighted ALERT INDICATOR identified track quality of hooked track. Alphanumeric indicator changes.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
	Taking local control of SAGE/BUIC tracks.	Gain close control of a SAGE/BUIC track.	Hook symbol and video tab appear at track coordinates.				
		Press LOCAL ENABLE pushbutton.		Local manual tracking is initiated.			
		Updating changing of coordinates or velocity may now be accomplished. To update see local updating procedure above.	Local full size symbol replaces S/B symbol, but S/B track number is retained. Remote indicator associated with symbol is deleted.				
9	Terminate local control of a SAGE/BUIC track.	Gain close control of local enabled SAGE/BUIC track.	Hook symbol and video tab appear at track coordinates.				
		Press LOCAL ENABLE pushbutton.		SAGE/BUIC input is restored.			

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Half size symbol from SAGE/BUIC is displayed at coordinates received from SAGE/BUIC. Remote indicator is restored to track symbol.
10
Fire unit has initiated an effective on an engaged track.
Fire unit effective message sent to SAGE/BUIC.
Message containing effective is sent to SAGE/BUIC.
Effective is received by SAGE/BUIC which discontinues passing track message and sends dump message for track.
SAGE/BUIC track disappears from display.
Decodes drop track message and removes track from stops.
Dump message sent to AADCP contains track number.
11
Enter sectors to inhibit auto tracking (dark target areas).
Press VIDEO TAB pushbutton.
Video tab appears at display origin.
Press ENABLE pushbutton.
Track ball control of video tab is enabled.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
		Move video tab to the counterclockwise short range corner of clutter sector.					
		Press ENTER SECTOR pushbutton.		Coordinates are entered.			
		Press ENABLE pushbutton.		Re-establishes track ball control of video tab.			
		Move video tab to the clockwise long range corner of the clutter sector.					
		Press ENTER SECTOR pushbutton.		Coordinates are entered auto track inhibited in sector.			

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12
Restore auto tracking to sectors previously inhibited.
Press VIDEO TAB pushbutton.
Video tab appears at display origin.
Inhibited sector is intensified by radar sweep. Video tab disappears.
Press ENABLE pushbutton.
Track ball control of video tab is enabled.
Move video tab to the counter-clockwise short range corner of sector to be erased.
Press ERASE SECTOR pushbutton.
Coordinates are entered.
Press ENABLE pushbutton.
Re-establishes track ball control of video tab.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
		Move video tab to the clockwise long range corner of the clutter sector.					
		Press ERASE SECTOR pushbutton.		Coordinates are entered, compared, and dark target sector is erased. Auto-track is restored.			
			Radar sweep intensification of sector ceases and auto track is restored in sector.				
13	Enter a jam strobe.	Press VIDEO TAB pushbutton.	Video tab is displayed at sweep origin.				
		Press ENABLE pushbutton.		Track ball control of video tab is enabled.			

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Move video tab away from origin and place it on the central bearing of the noise source.

Press JAM STROBE pushbutton.

Jam strobe is generated. Message is sent to all remote sources. Strobe sent to display.

Jam strobe message containing coordinates and jam strobe indicator.

Jam strobe message received by all remote sources, adjacent AADCP and RRIS and displayed at adjacent AADCP's only.

Jam strobe is displayed starting at origin and extending to CRT edge.

14 Determine location of ECM emitter.

Adjacent AADCP and RRIS sites can generate jam strobe in same manner as indicated above. Message is sent to AADCP giving ECM emitter bearing.

Track may be entered at intersection of jam strobe and designated to fire unit by tactical console operator.

Jam strobe(s) are displayed at console if JAM STROBE selector is on.

Remote source message is decoded and stored. Jam strobe(s) are presented to display.

Message giving coordinates and special jam strobe indicator sent to AADCP.

15 Drop A JAM strobe.

Press VIDEO TAB push-button.

Video tab appears at display origin.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
		Press JAM STROBE pushbutton.	Both jam strobe and video tab disappear.				
16	Enter track height.	Gain close control of track.	Hook symbol and video tab appear at track coordinates.				
		Set height into the three decimal digits of NUMBER ENTRY dials.					
		Press ENTER HEIGHT pushbutton.		Height is entered into appropriate store. Height sent to display.			
			Track height is displayed with track alphanumerics.				
17	Display extended vectors.	Gain close control of track.	Hook symbol and video tab appear at track coordinates.				

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Press EXTENDED VECTORS pushbutton.
Adjustable vector displayed at origin of hooked symbol.
Set TIME TO GO dial to desired elapsed time.
Note. Time to go selectable in increments of ¼ min. between 0–4 minutes and ½ min. between 4–8 minutes.
Terminus of vector is extrapolated. Position sent to display.
Length of vector changes indicating predicted point at elapsed time.
18
Observation and entry of remote source tracks.
Adjacent AADCP's and RRIS transmit all tracks in memory to the AADCP in digital data form including one jam strobe each.
Observe and correlate incoming tracks with target video if available.
Displays symbols of appropriate size and identity on all scopes which have cat. selected to display adj. AADCP and/or RRIS tracks.
Decode received messages from remote sources both adjacent AADCP and RRIS. Integrates velocity. Sends coordinates, identity, track number, height raid size to display.
Message contain identity positional and velocity coordinates raid size and special indicator are sent to AADCP.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
19	Flag track as special.	Gain close control of track.	Hook symbol and video tat appear at track co-ordinates.				
		Set special type (A, B, C) into letter dial of NUMBER ENTRY dials.					
		Press SPECIAL TRACK pushbutton.		SPECIAL recorded in memory. Message formatted and sent to remote sites, SPECIAL sent to display.	Message containing SPECIAL indicator coordinate data raid size identity, sent to remote source.		Symbol changes to special with type A, B, or C indicated at all remote sites.
			Special symbol and type classification A, B, C are displayed.				
	Return special track to normal classification.	Gain close control of special track.	Hook symbol and video tab appear at track co-ordinates.				
		Press SPECIAL TRACK pushbutton.		Symbol returned to normal classification.			

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Display of symbol returned to normal.
20
Request dropping of remote track.
Gain close control of remote track.
Hook symbol and video tab appear at track coordinates.
Press DROP TRACK pushbutton.
Symbol change and designator letter change to category D. MESSAGE REQUEST DROP TRACK is sent to remote source.
Complete remote source message containing SPECIAL D sent to remote source.
Track symbol at remote site changes to SPECIAL D.
Track symbol changes to special with category D designator.
Symbol disappears from display.
Drop track message causes drop of track at AADCP.
Drop track plus complete remote source message sent to AADCP.
Remote source initiates drop track.
21
Drop local track.
Gain close control of local track.
Hook symbol and video tab appear at track coordinates.

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Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
		Press DROP TRACK pushbutton.		Track is erased from local store.	Drop track plus complete remote source message sent to remote sources.		Track is erased from store at remote site. Symbol disappears from display.
			Track disappears from display.				
22	Clutter is degrading auto track function in data processor.	Use ENTER SECTORS as described above.	AUTO TRACK OVERFLOW indicator glows.	After entry of sufficient inhibit sectors, signal sent to display.			
			Auto track overflow indicator lamp goes out.				
23	Determine reason for blinking track.	Gain close control of blinking track.	Hook symbol and video tab appear at track coordinates.				
			Alert lamps indicate reason(s) for blinking track as follows.				

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Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
			One of four alert indicator lamps light.				
		No action required.	GOOD AUTO				
		No action required.	GOOD MANUAL				
		Either enter a manual up-date or transfer to auto-tracking.	POOR MANUAL indicator lamp lights.	Time from last up-date of manual track is too long as determined by elasped time counter.			
			POOR MANUAL indicator lamp goes out.	Timer is reset or data is now correlated.			
		Wait for improved quality of auto tracking or change to manual and up-date.	POOR AUTO TRACKING lamp lights.	Correlation indicates poor auto tracking.			

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Data is now correlated or timer is reset.
POOR AUTO TRACKING lamp goes out.
25
Illegal entry.
Press button out of sequence.
Sequence checking signal sent to display.
IMPOSSIBLE REQUEST lamps light.
26
Make height request.
Gain close control of track by means of symbol tab.
Hook symbol and symbol tab appear at track coordinates.
Press height REQ–1 or 2 pushbutton.
Height request is formulated and transmitted to specified height finder facility.
Message contained coordinates X and Y data plus height finder demand is sent.
Message decoded and height finder turns to directed bearing and range search in elevation.
Operator measures target height. Message formulated and returned to AADCP.
Message giving height reply is returned.
Data message received from height finder.
Track blinks at display see above procedure for blinking tracks.

Table 6 (C). Tracking Mode Functions (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data display	Computer processing	Data exchanged	SAGE/BUIC	Remote source
27	Enter new local track for auto track (skin/beacon).	Press VIDEO TAB pushbutton.	Video tab appears at display center.				
		Press ENABLE pushbutton.		Video tab is enabled and can now be moved under control of track ball.			
		Use TRACK BALL to position video tab over video.					
	Notes. This sequence is based on the following assumptions: 1. The operator has retained close control of the new track. 2. The track (video) has moved so as to justify an update entry.	Press NEW TRACK pushbutton.	Unknown track symbol appears at coordinates of video tab and hook symbol appears around symbol.	New track initiated and entered into memory as manual track. Message sent to remotes.		Digital message containing special status and track coordinates is sent to remote sources.	Track data sent to all remote sources, adjacent AADCP's and RRIS.
		Use TRACK BALL to position video tab over target video.					

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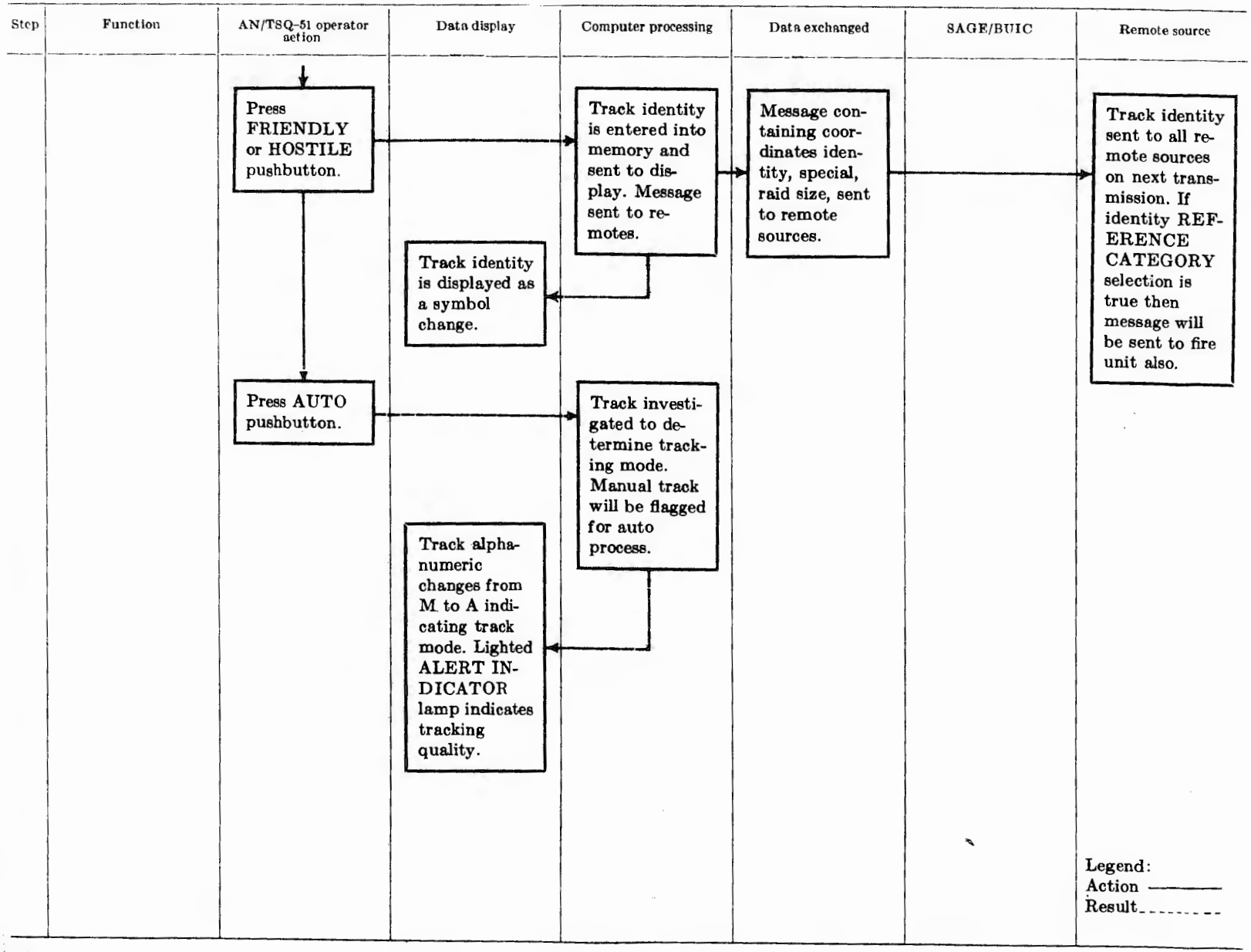
Press UP-DATE push-button.
Velocity up-date automati-cally com-puted based on new position and time differential.
Track symbol and hook sym-bol are reposi-tioned to video tab coordi-nates.
Circle jump continues to update symbol to video.
Integration of velocity con-tinues to update.
Press SIN-GLE, FEW, or MANY pushbutton.
Raid size is entered into memory and sent to dis-play. Message sent to re-motes.
Message con-taining coordi-nates, special and raid size sent to remote sources.
Raid size sent to all remote sources on next transmission.
Raid size of S, F, M is displayed w'th track alpha-numerics.

Table 6 (C). Tracking Mode Functions (U)—Continued



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c. Table 7 shows the step-by-step procedure for placing a general purpose console in the tactical mode of operation and continues with an explanation of the functions used by a tactical console operator regardless of the method of control (centralized or decentralized) being exercised over the fire units.

Table 7 (C). Tactical Mode of Operation (U)

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit display	Fire unit actions
	Establish tactical display.						
1	Assume tactical mode.	Turn console MODE switch to TACT.	All tactical entry buttons extinguished.				
		Press ENTER MODE pushbutton.		Change mode function code received.			
			Tactical action entry buttons illuminated.	Console mode change directed.			
2	Couple desired fire units to console.	Press SYMBOL TAB pushbutton.	Control marker displayed at scope center.				
		Press ENABLE pushbutton.		Track ball control of symbol is enabled.			

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Table 7 (C). Tactical Mode of Operation (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit display	Fire unit actions
		Position symbol tab over fire unit site symbol.					
		Press FIRE UNIT HOOK pushbutton.	Hook symbol appears around FU site symbol.				
		Press FIRE UNIT TO CONSOLE pushbutton.		Fire unit is coupled to console.			
			Console number (1–8) is displayed in FU alpha-numerics.				
	Repeat for each FU desired.						
3	Gain close control of track.	Dial track number in NUMBER ENTRY switches.					

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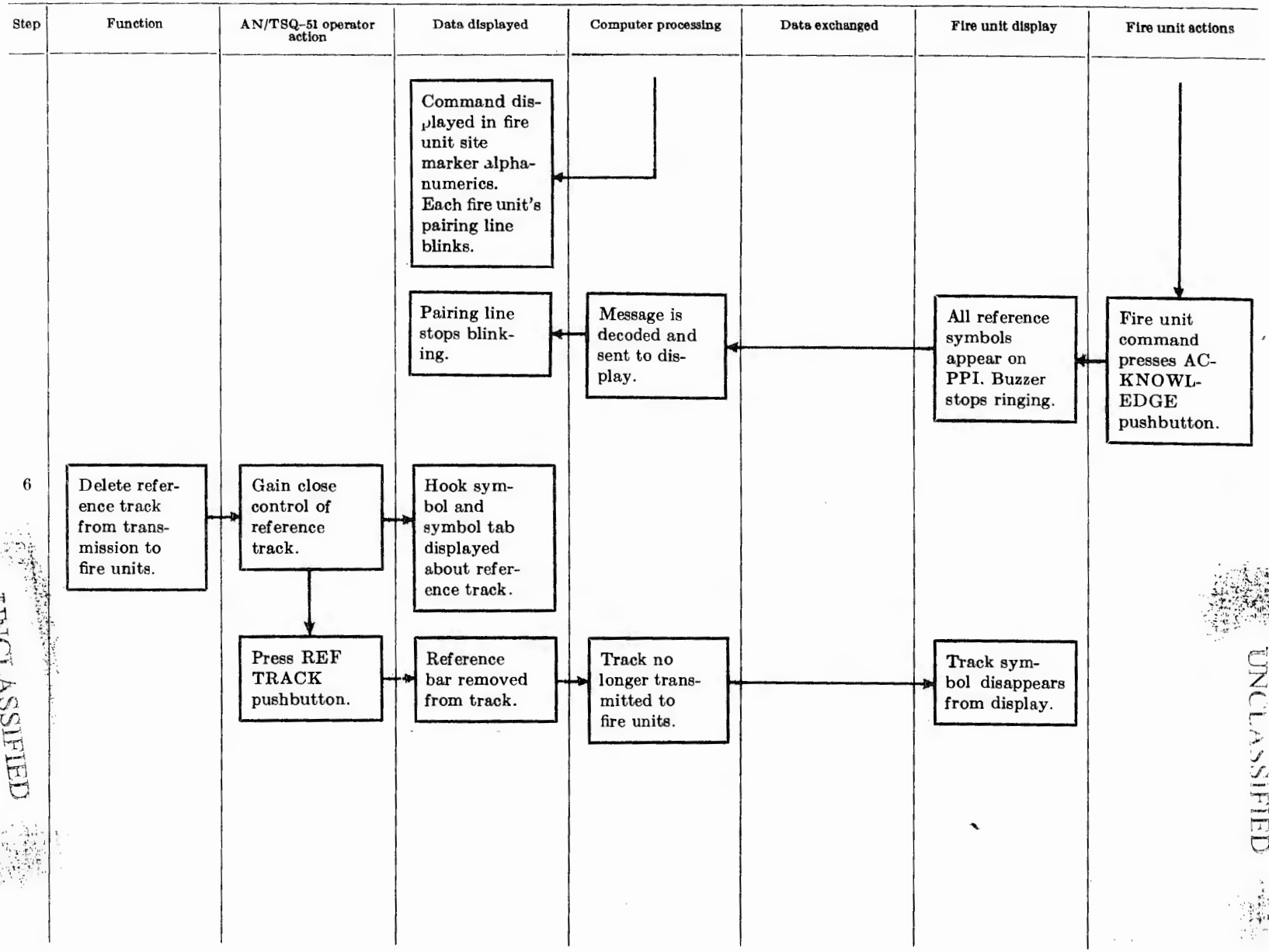
Press LR/TN HOOK or SB/TN HOOK pushbutton.
Track number received. Memory searched. Symbol coordinates sent to position the hook symbol.
Hook symbol and symbol tab appears around desired trk.
4
Send individually selected reference trks to all fire units.
Gain close control of non-reference trk.
Hook symbol and symbol tab appears around desired trk.
Press REFERENCE TRACK pushbutton.
Reference track indicator added to track symbol.
Hooked track is marked for reference.
REFERENCE track sent to all fire units.
Referenced track will be displayed at all fire units.
5
Send HOLD FIRE command to all fire units paired to a single track.
Gain close control of track.
Hook symbol and sym tab displayed at track coordinates.
Press HOLD FIRE pushbutton.
HOLD FIRE message sent to all fire units paired to that track.
If lighted REMOTE lamp goes out HOLD FIRE lamp is lighted. Buzzer sounds. All but the designated symbol disappears.
Fire unit destructs any in-flight weapon and holds fire.

Table 7 (C). Tactical Mode of Operation (U)—Continued



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7	Sequentially gain close control of track.	Press SEQ HOOK pushbutton.	Hook symbol and symbol tab displayed around next track in tactical sequence.	
8	Take action relative to blinking track.	Gain close control of blinking track.	Hook symbol and symbol tab displayed at track coordinates. Alert light(s) indicate reason for blink. High threat requires operator action.	
		ENGAGE command may be sent as indicated in centralized mode.		
9	Check track threat index.	Gain close control of desired track.	Hook symbol and symbol tab appear around track symbol.	Computer checks threat index. Sends threat index to display.
			Action entry panel displays appropriate threat index HIGH, MEDIUM, LOW, NO-THREAT.	

Table 7 (C). Tactical Mode of Operation (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit display	Fire unit actions
10	Illegal entry.	Press push-button in a sequence other than one defined for tactical operations.	IMPOSSIBLE REQUEST lamp is lighted.	Mis-sequence determined. Signal sent to display.			
11	Send reference tracks to all fire units by IDENTITY.	On the display rack panel set the CATEGORY REFERENCE switches at FRIENDLY or HOSTILE (or both).	Track of selected identity will be displayed with a horizontal reference bar included in symbol.	Track memory searched. Track of selected identity will be sent to fire units. Reference bar will be sent to display.	REFERENCED messages containing identity and coordinates will be sent to all fire units on those tracks having identity as selected (this includes SAGE/BUIC sim. tracks if such tracks are switch-selected at the AADCP).	All reference tracks of the AADCP-selected-ID will be displayed on the PPI provided they are in range fire unit.	BCO observes display and evaluates air situation.

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d. Table 8 shows the sequence which a fire unit follows and the resultant effects of both the fire unit and the AADCP whenever the fire unit initiates a track. Even though a fire unit initiates a track and proceeds to engage it, a HOLD FIRE command could still be implemented on the track by the AADCP as explained in paragraph 37*g*.

Table 8 (C). Engagement Sequence—Tactical Mode Decentralized (U)

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit/battery display	Fire unit/battery action
1	Battery initiated action.						Fire unit LOCAL push-button pressed.
				Decodes fire unit message. Stores status. Status sent to display.	Upon next interrogation fire unit report back message is sent. Status bits indicate READY to AADCP.	LOCAL lamp on status panel is lighted.	
2		Observes fire unit site marker alphanumerics for appropriate indicator.	FU status of READY(R) is indicated in FU alphanumerics.	Message formatted for report to SAGE/BUIC.	Status message sent to SAGE/BUIC indicating FU number and status.		
			Status panel STS column now reads R.				Battery control officer (BCO) observes PPI display and selects target.

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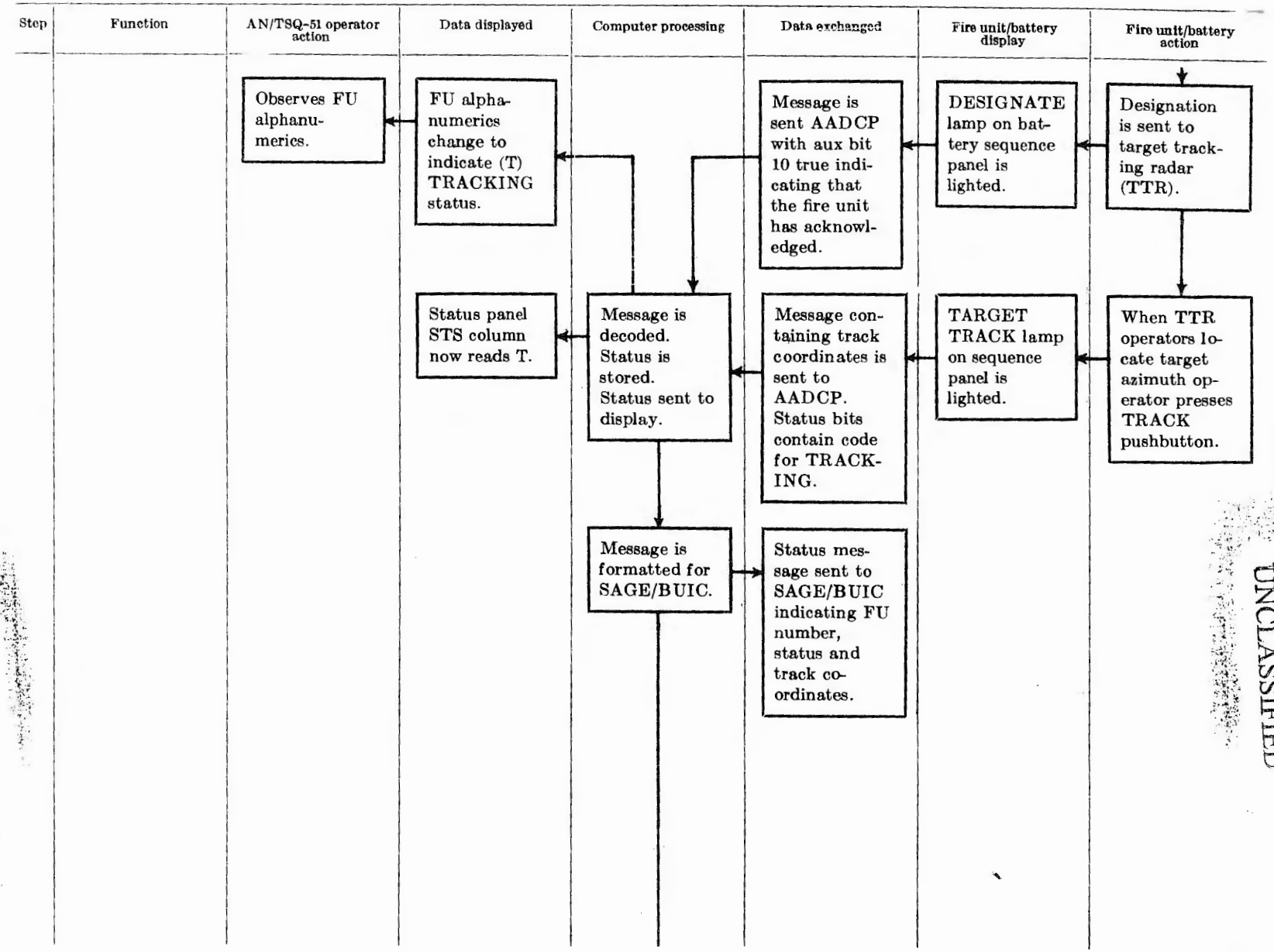
Table 8 (C). Engagement Sequence—Tactical Mode Decentralized (U)—Continued



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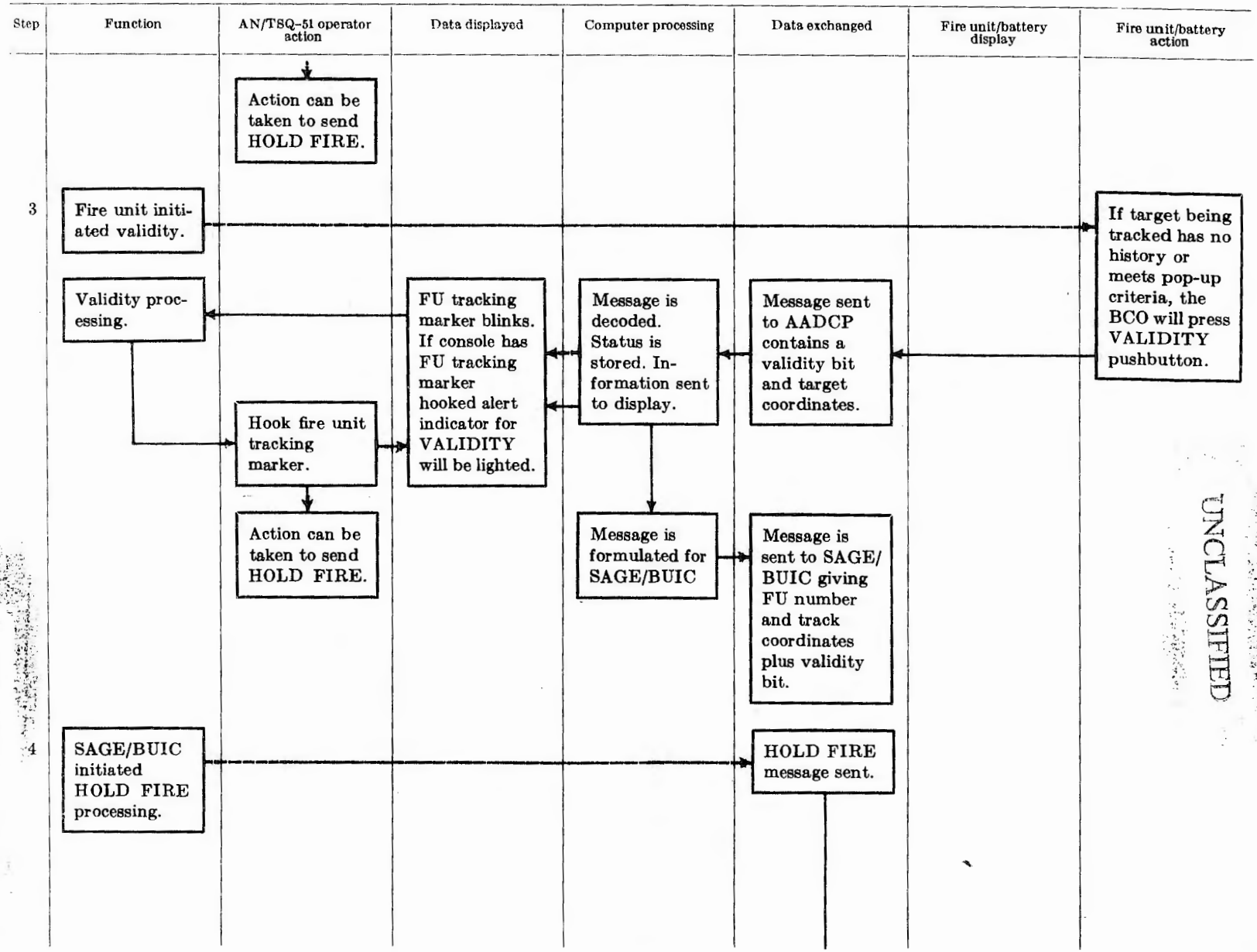
Correlation performed to determine if fire unit had been designated this target.
Fire unit tracking marker appears at lock-on coordinates and site marker blinks. No pairing line associated.
Observe display or initiate action to further identify fire unit which initiated action.
Further identify FU initiated tracking action.
Press SYMBOL TAB pushbutton.
Symbol tab appears at origin.
Press ENABLE pushbutton.
Track ball control of symbol tab is enabled.
Move symbol tab over fire unit tracking marker which is blinking.
Press FU HOOK pushbutton.
Hook symbol appears around FU tracking marker. Associated alphanumerics are displayed.

Table 8 (C). Engagement Sequence—Tactical Mode Decentralized (U)—Continued



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Operator verbally acknowledges HOLD FIRE from SAGE/ BUIC.
SAGE/BUIC track symbol blinks.
SAGE/BUIC message is decoded. Fire unit(s) paired with that track number will be selected. HOLD FIRE message is formulated. Designation sent to fire unit(s) selected.
Primary command in fire unit alpha-numerics reads H (HOLD FIRE).
HOLD FIRE designation message sent to fire unit(s).
HOLD FIRE lamp is lighted. All symbols except that for the track designated disappear. Buzzer is sounded.
BCO destructs any in-flight missile. HOLD FIRE command is effected.
Fire unit(s) pairing line(s) blinks.
BCO presses ACKNOWL-EDGE push-button and instructs TTR to maintain tracking.

Table 8 (C). Engagement Sequence—Tactical Mode Decentralized (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit/battery display	Fire unit/battery action
		Operator observes satisfactory completion. SAGE/BUIC is informed verbally.	TRACKING status displayed in fire units alphanumerics. Pairing line(s) stops blinking. SAGE/BUIC track symbol stops blinking only after SAGE/BUIC removes priority bit.	FU message is decoded.	Message containing acknowledge is returned to AADCP.	Buzzer stops sounding. All reference symbols reappear.	
5	Battery initiates raid size.						BCO observes radar presentation on TTR display to determine number of targets in track and presses one of the raid size pushbuttons.
						ONE lamp on status panel is lighted.	Press raid size ONE pushbutton.

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Press raid size FEW pushbutton.
FEW lamp on status panel is lighted.
On next interrogate, FU sent message indicating raid size.
Decodes FU message. Raid size stored. Raid size sent to display.
Raid size estimate is displayed in fire unit tracking marker alphanumerics.
Observes FU alphanumerics.
Operator verbally verifies the raid size change.
Press raid size MANY pushbutton.
MANY lamp on status panel is lighted.
6
Fire unit continuation of engagement.
When READY TO FIRE lamp is lighted and warhead size has been selected, the BCO presses FIRE pushbutton.
FIRE lamp on sequence panel is lighted.
Message containing status of FIRING is sent to AADCP.
Decodes message. Stores status. Sends new status to display.
Status of FIRING is indicated in fire unit alphanumerics.
Observes FU alphanumerics.
Status panel STS reads F.
LAUNCH lamp is lighted when missile is away.
BURST lamp is lighted when missile intercepts target.
BCO evaluates intercept and takes one of the following actions.

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Table 8 (C). Engagement Sequence—Tactical Mode Decentralized (U)—Continued

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit/battery display	Fire unit/battery action
						EFFECTIVE lamp on status panel is lighted.	Press EFFECTIVE pushbutton.
		Observes FU alphanumerics.	FU alphanumerics change to new status.	Decodes FU message. Stores FU status. Status sent to display.	FU message sent to AADCP containing one of the codes corresponding to pushbutton pressed.	INEFFECTIVE lamp on status panel is lighted.	Press INEFFECTIVE pushbutton.
		Tactical monitor makes damage assessment.	Status change displayed on status board.	Message formulated and sent to SAGE/BUIC.			Press KILL pushbutton.
					Message containing effectivity of FU and associated track number is sent to SAGE/BUIC.		
7	Fire unit assumes READY status.						BCO returns fire unit to READY for next engagement.

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Observes fire unit alpha-numerics.
FU status is displayed in alpha-numerics.
Status changes on status panel.
Message is decoded. Status stored and sent to display and SAGE/BUIC.
Message containing READY is formulated and sent to AADCP.
EFFECTIVE or INEFFEC-TIVE lamp, if lighted, goes out. LOCAL lamp is lighted.
BCO presses LOCAL pushbutton.

e. Table 9 shows the sequence which a tactical console operator uses to assign tracks and terminate engagements of these tracks by the fire units.

Table 9 (C). Engagement Sequence—Tactical Mode Centralized (U)

Step	Function	AN/TSQ-51 operator action	Data displayed	Computer processing	Data exchanged	Fire unit/battery display	Fire unit/battery action
1	Designate a track to a fire unit.	Gain close control of hostile or friendly track to be assigned.	Hook symbol and symbol tab are displayed at track coordinates.		*Notes.* Periodic status messages report fire unit status to SAGE/BUIC.		
		Press ENABLE pushbutton.		Track ball control of symbol tab is enabled.			
		Position symbol tab over the fire unit site marker.					
		Press ENGAGE TRACK pushbutton.	Primary designation flag appears at track coordinates joined to fire unit by blinking pairing line. Fire unit site marker blinks. E appears in primary command A/N readout position.	ENGAGE command containing target coordinates is formatted.	At time slot for the fire unit the engage message is transmitted upon interrogation.	LOCAL lamp goes out. REMOTE lamp is lighted. Buzzer is sounded. All reference symbols disappear from PPI. Only designate symbol appears on PPI.	BCO observes designated symbol to establish radar contact.
							Acquisition steerable AZIMUTH MARKER and RANGE MARK are placed over video.

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BCO DESIGNATES target to TTR.

TTR radar acquires target and initiates LOCK-ON.

BCO observes PPI display to make raid size estimate. After estimate is complete one of the following raid size push-buttons is pressed.

TARGET TRACK on sequence panel. Message sent to AADCP.

Buzzer stops ringing. DESIGNATE lamp is lighted on sequence panel. Message sent to AADCP.

Message reply to AADCP containing status report of TRACKING.

Message reply to AADCP containing ACKNOWLEDGE.

Fire unit message decoded. Status stored. Coordinates processed. Sent to display.

Fire unit message decoded. Status stored and processed to change display.

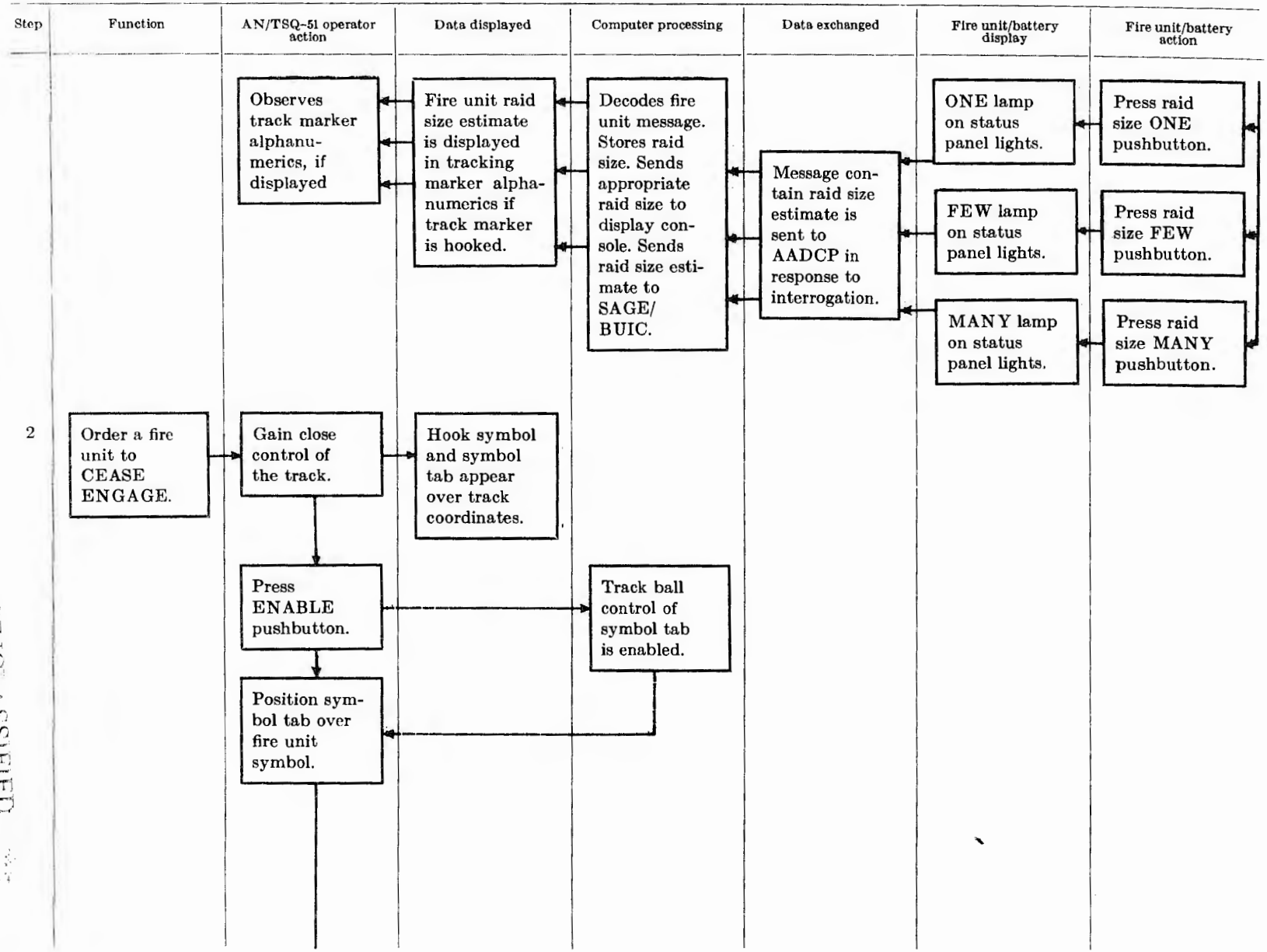
Track status presented in FU alphanumerics. Designation flag becomes a fire unit tracking marker. FU site marker stops blinking.

Pairing line stops blinking.

Status displayed on status board.

Command and track number is displayed on status board.

Table 9 (C). Engagement Sequence—Tactical Mode Centralized (U)—Continued



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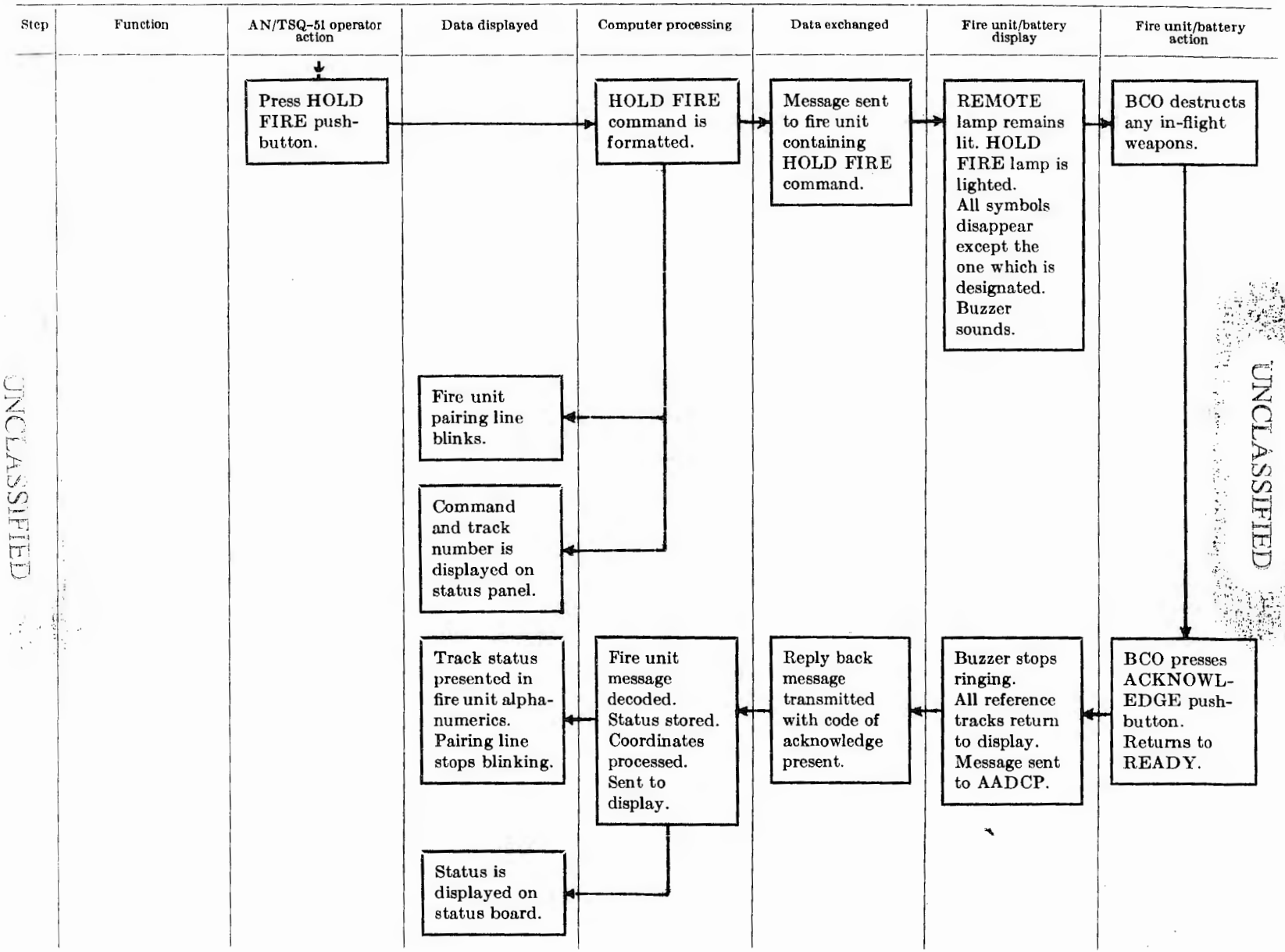
Press CEASE ENGAGE pushbutton.
C appears in primary command A/N read-out position.
CEASE ENGAGE command is formatted.
Message containing CEASE ENGAGE command is sent to fire unit.
REMOTE lamp remains lit. CEASE FIRE lamp lights. All symbols disappear except the one designated for hold fire. Buzzer sounds.
See note below
BCO requests continued track but not to fire.
Pairing line blinks.
Command and track number displayed on status board.
May automatically go to secondary designation.
Track status displayed in fire unit alphanumerics. Pairing line disappears.
Fire unit message is decoded. Status stored. Status sent to display.
Message reply returned containing acknowledge.
Buzzer stops. All reference symbols return. Message sent to AADCP.
BCO sends acknowledge by pressing ACKNOWLEDGE pushbutton.
3
Order a fire unit to HOLD FIRE.
Gain close control of the fire unit tracking marker.
Hook symbol and symbol tab displayed at track number coordinates.

Table 9 (C). Engagement Sequence—Tactical Mode Centralized (U)—Continued



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If the command of CEASE ENGAGE or HOLD FIRE is not sent the fire unit continues a normal engagement.

When READY TO FIRE lamp is lighted. Warhead size is selected. Missile is ready. BCO presses FIRE pushbutton.

FIRE lamp is lighted on sequence panel. Message sent to AADCP.

Message sent containing a status of firing.

Decodes FU message. Stores status. Sends status change to display.

Status of firing is displayed in FU alphanumerics.

Observes fire unit alphanumerics.

Status is displayed on status board.

LAUNCH lamp is lighted on sequence panel when missile is away.

BURST lamp is lighted when missile intercepts target.

After completion of engagement BCO takes any of the following actions depending on his evaluation:

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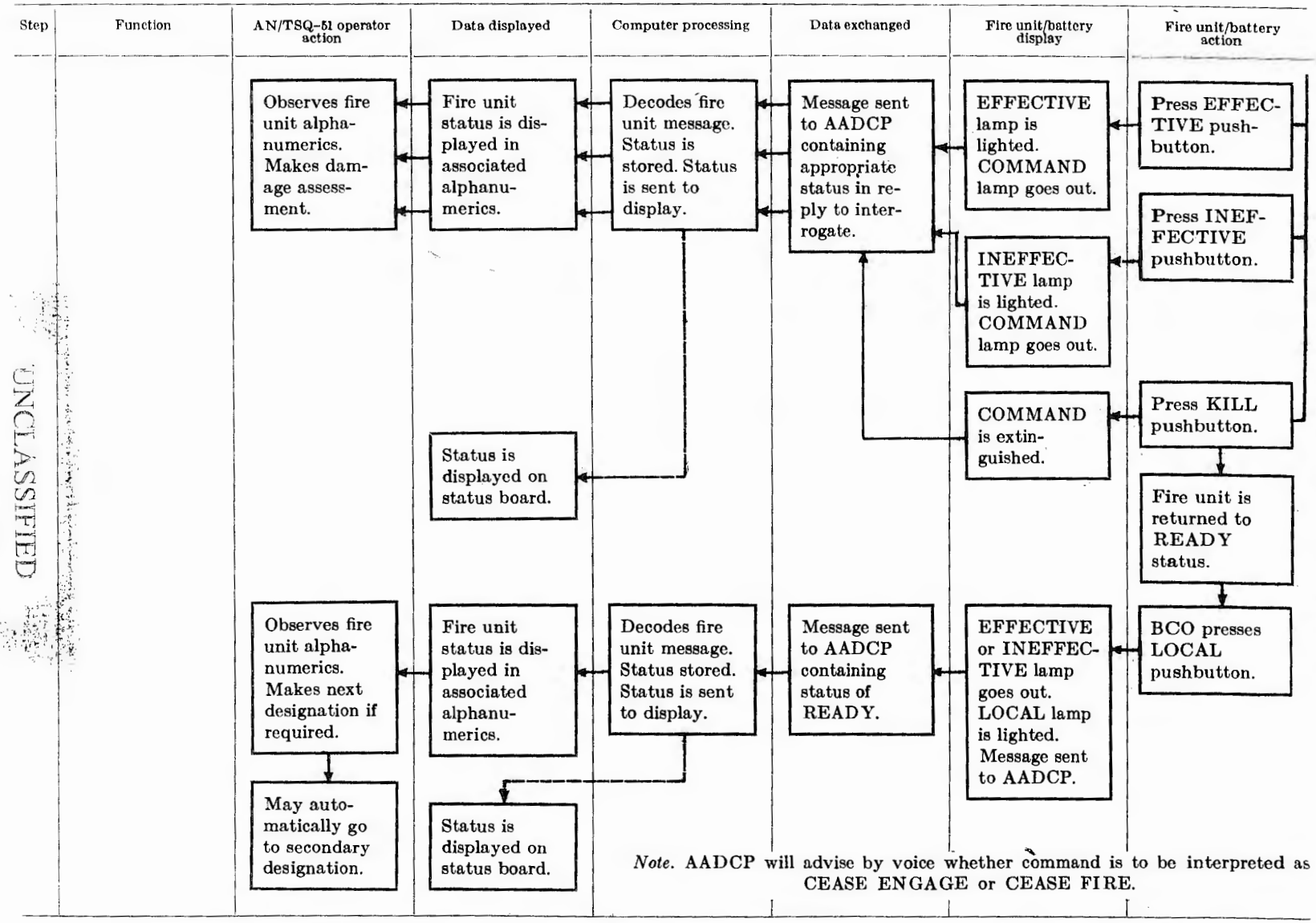
Table 9 (C). Engagement Sequence—Tactical Mode Centralized (U)—Continued



Note. AADCP will advise by voice whether command is to be interpreted as CEASE ENGAGE or CEASE FIRE.

f. The tracking mode functions apply to operation of a console at an RRIS except for those functions associated with automatic tracking of targets, handling of SAGE/BUIC tracks, and the entry and erasure of sector video.

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CHAPTER 7 (U)
DECONTAMINATION OF EQUIPMENT (U)

39. (U) General

Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a serious danger to personnel. Contamination is the spreading of an injurious agent in any form by any means. Personnel, objects, or terrain may become contaminated. Decontamination is the process of making any contaminated place or object safe for unprotected personnel. It can be accomplished by covering, removing, destroying, or rendering harmless the contaminating agent or agents. Generally, only that equipment contaminated by persistent agents need be decontaminated. Personnel performing CBR decontamination should wear protective masks and personal clothing buttoned at the neck and tied at the wrists and ankles with string if special clothing is not available.

40. (U) Decontamination for Chemical Agents

When contaminated by chemical agents, decontaminate the exposed interior and exterior surfaces of the equipment installed in the trailers and the power generating equipment in the following manner:

a. With rags, wipe off all visible contaminant. Apply decontaminating agent, noncorrosive, M4 (DANC), or decontaminating agent DS–2, wipe with a gasoline-soaked rag, and then dry with a clean rag. If DANC or DS–2 is not available, scrub the contaminated areas with soap and cold water. Remove any air filters, clean by soaking in gasoline, drain and air dry, coat with heavy oil (if applicable), and reinstall.

b. Do not use DANC or DS–2 on cables or on rubber or plastic components. Soap and cold water should be used for these items.

c. Dispose of contaminated rags and any clothing that may have become contaminated by burning or burying, and exercise care in the disposal of soap and water used in decontamination.

41. (U) Decontamination for Biological and Radiological Agents

a. General. After an attack involving biological or radiological agents, equipment recovery and decontamination may be achieved by waiting to permit decay of contaminants, or by actively decontaminating the equipment to neutralize or remove the contaminant. When the urgency of the military situation requires early use of the equipment, active decontamination is initiated to reduce the contamination level sufficiently to permit personnel to work with, or close to, equipment for limited periods.

b. Biological Decontamination. Any agent that destroys or removes a chemical contaminant is effective against most biological agents. Water or steam (when available) and soap or other detergents effectively dilute and wash away particles of the contaminant. DANC or DS–2 is effective against residual contamination that may not be washed away.

c. Radiological Decontamination. Contaminants from fallout are usually finely divided particles which adhere closely to materials and tend to settle into pores and crevices. Decontaminants that have good cleaning characteristics are effective against radiological contamination. Initial decontamination may be accomplished by hosing with plenty of water followed by scrubbing with soap and water, and then by vigorous brushing.

d. Waste Disposal. Clothing and rags used during decontamination for biological and radiological agents become contaminated and should be burned or buried. Care must be exercised in disposal of soap or water used.

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APPENDIX A (U)

REFERENCES (U)

Department of the Army pamphlets of the 310-series should be consulted for the latest changes or revisions of references given in this appendix and for new publications relating to materials covered in this manual.

AR 320–5	Dictionary of United States Army Terms.
AR 320–50	Authorized Abbreviations and Brevity Codes.
FM 21–11	First Aid for Soldiers.
FM 44–1	U.S. Army Air Defense Employment.
(C) JCS Pub. 10	Tactical Communications and Control Systems Standards (U).
TM 3–220	Chemical, Biological, and Radiological (CBR) Decontamination.
(CM) TM 9–1430–560	Overall System Description (Air Defense Fire Distribution System AN/TSQ–51) (U).
(CM) TM 9–1430–560–10/1	Operator's Manual (Air Defense Fire Distribution System AN/TSQ–51) (U).
(CM) TM 9–1430–560–24/2	Organizational, DS, and GS Maintenance Manual: System Maintenance (Air Defense Fire Distribution System AN/TSQ–51) (U).
TM 9–1430–560–24/5	Organizational, DS, and GS Maintenance Manual: Description and Maintenance Instructions AADCP and RRIS Computer Function (Air Defense Fire Distribution System AN/TSQ–51).
TM 9–1430–560–24/7	Organizational, DS, and GS Maintenance Manual: Description and Maintenance Instructions: AADCP and RRIS Data Processor Console (Air Defense Fire Distribution System AN/TSQ–51).

By Order of the Secretary of the Army:

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Major General, United States Army,
The Adjutant General.

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